P. F. Harrington,
Captain, U. S. Navy.

W. R. GRACE & CO.,

LIMA AND CALLAO,
PERU.

Contractors
TO THE
United States
AND
Other Navies

FOR THE
Supply of . . .

Coal and
Provisions.

W. R. GRACE & CO.

New York, London, Lima, Valparaiso, San Francisco,
Callao, Santiago, Concepcion.

Commission and Forwarding Agents.

Agents of the New York and Pacific Steamship Co.

"MERCHANTS' LINE,"

MONTHLY SAILINGS FROM NEW YORK TO THE WEST COAST

NEW BOOKS

PUBLISHED BY THE U. S. NAVAL INSTITUTE.

The Log of the Gloucester.

Commanded by Lt.-Commander Richard Wainwright. The Official Report of the Principal Events of her Cruise during the Late War with Spain, including the destruction of the Spanish Destroyers, the Rescue of Admiral Cervera, and her famous capture of Guanica. Published by authority of the Navy Department.

Handsome large 8vo, deckle-edge paper, 188 pages, illustrated. Bound in full cloth. Price $1.50.

Hand-Book of Infantry and Artillery for the U. S. Navy.

By Lieutenant W. F. Fullam, U. S. Navy. Approved by the Navy Department. Fully illustrated. The book has been carefully planned to make it compact, and convenient for the pocket; many additional diagrams, showing formations at a glance; especially desirable for Naval Reserves and landing parties.

Handsomely bound in flexible blue leather with gold lettering. Price $1.25.

Pamphlet of Instructions for Loading and Firing for the United States Navy, Krag-Jorgensen Rifle, Calibre .30.

Prepared under the direction of the Bureau of Navigation, Navy Department, by U. S. Naval Institute, Annapolis, Md.

These Instructions are paged, paragraphed and arranged for pasting in the Hand-Book for Infantry and Artillery, 1899. Price, 6 Cents.

An Aid for Executive and Division Officers.

Compiled by Lieut. Chas. A. Gove, U. S. Navy. The book contains blank forms ruled, with watch numbers, gun numbers, etc., in proper columns; for use of Executive in his organization, and for the division officer in stationing his men. The paper is especially tough to withstand erasures.

Part I.—Contains a description of the organization: the "Watch, Quarter and Station Bills." The Stations for "Fire Quarters," General Quarters, Collision Quarters, Getting Underway, Mooring and Unmooring; also the Battle, Boat, Battalion, and Messing Bills.

Part II.—Contains forms for all routine matters.

Part III.—Memoranda.

The principal object of this book is to have at hand a systematized plan, and blank forms, that can be used in all types of ships. The scheme adopted has been successfully tried on several vessels of the New Navy.

Durably bound in imitation seal with gold lettering. Price $1.50.

To members of the Institute at cost.

A Text-Book of Ordnance and Gunnery.

By Commander R. R. Ingersoll, U. S. Navy. This book has just been thoroughly revised and enlarged. The latest turret mounts and types of guns adopted by the Department appear in this edition. The machine gun is also brought up to date.

This book is of especial value to officers of the new line preparing for their examination. Adopted as text book at U. S. Naval Academy. Price, $3.50.

8vo, 324 pages and 153 full-page plates.

Explorations in Alaska.

By Lieut.-Commander George M. Stoney, U. S. Navy. In order to supply the readers of the Institute with this interesting narrative in book form, and to supply the demand for copies from the general public, a limited number of copies have been bound in cloth, with tasteful and appropriate design upon cover. Price, $1.50.

Gun and Torpedo Drills for the U. S. Navy.

Prepared by Lieutenant E. W. Eberle, U. S. Navy, under the direction of the Bureau of Navigation, Navy Department. The book is of convenient size for the pocket. A valuable book for the Naval Reserves. For sale after February 10, 1901.

Handsomely bound in flexible blue Russia leather with gold lettering. Price $1.00.

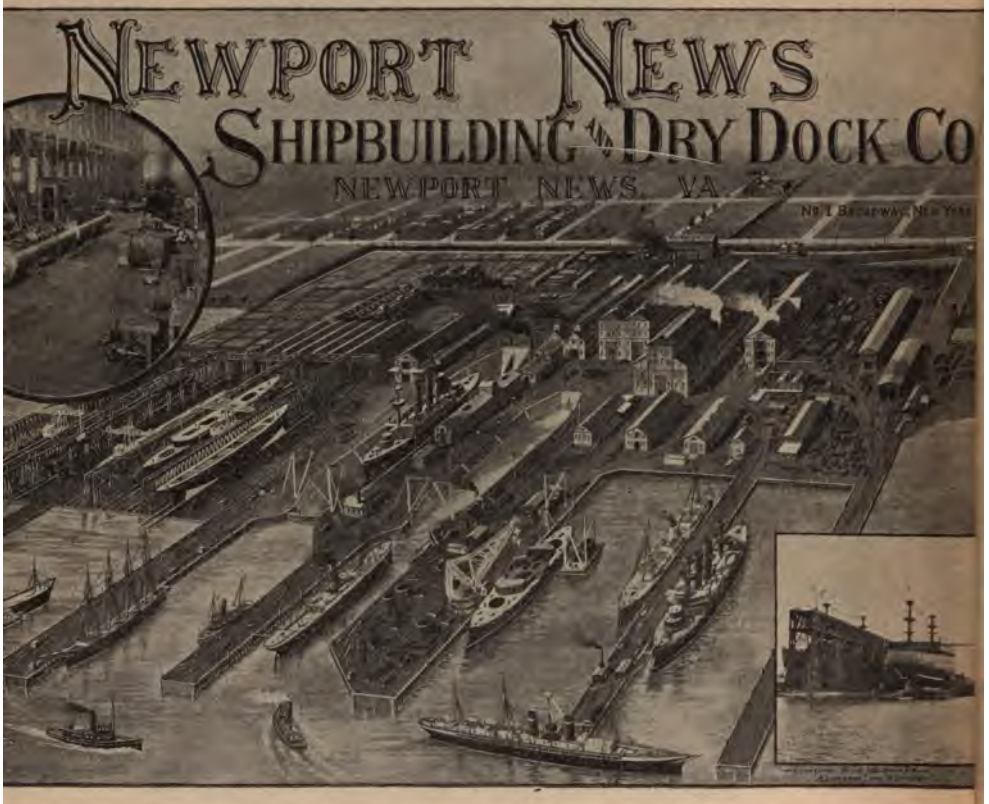
Notes on Steam Engineering.

Arranged for the use of Officers of the Old Line of the Navy. For sale after Nov. 15, 1901.

8vo., 154 pages. Bound in full cloth, Price $1.50.
Bound in paper, Price, $1.00.

Address all orders to the

SECRETARY AND TREASURER
of the U. S. Naval Institute,
ANNAPOLIS, MD.



DRY DOCKS.

	No. 1.	No. 2.
Length on Top	610 Ft.	827 Ft.
Width on Top	130 "	162 "
Width on Bottom	50 "	80 "
Draught of Water over Sill	25 "	30 "

DESCRIPTION OF WORKS.

Ship Yard contains	120 Acres.
Buildings cover	10 "
Frontage on the Water	2,600 Ft.
Outfitting Basin	900x500 "

PIERS.

No. 1	60x900 Ft.	No. 4	80x550 Ft.
" 2	60x850 "	" 5	60x750 "
" 3	191x800 "	" 6	60x500 "

BUILDINGS.

Machine Shop, Brick	100x500 Ft.
Boiler Shop, "	100x300 "
Blacksmith Shop, "	100x300 "
Ship Shed, "	60x320 "
Joiner Shop, "	60x300 "
Framing Shed, "	270x344 "
Shears	100 Tons Capacity.
Revolving Derrick,	150 " "

Shops are equipped with modern machinery capable of doing the largest work required in ship construction. Tools driven by electricity and compressed air largely used in building and repairing vessels.

Henry Clay and Bock & Co.

THE HAVANA CIGAR & TOBACCO FACTORIES

(LIMITED.)

PAID UP CAPITAL, - - - $7,000,000—GOLD.

CIGAR FACTORIES:

AGUILA DE ORO, (Bock & Co.,) Concepción de la Valla No. 5, 7, 9 & 11.
HENRY CLAY, (Julian Alvarez), Calzada Luyanó No. 98 & 100.
INTIMIDAD, (Antonio Caruncho), Calzada Belascoain No. 34.
ESPAÑOLA, (Fueyo & Co.,) Consulado Street No. 91 & 93.
CORONA, (Alvarez & Lopez), Calzada de la Reina No. 1.
ROSA DE SANTIAGO, (Roger & Co.,) Calzada Belascoain No. 2 C.
FLOR DE NAVES, (Cueto Ho.,) Estrella Street No. 19.
ESTELLA, (Cortina & Gomez), Marques Gonzalez Street No. 10.
PROMINENTE, (A. Muro), Dragones Street, No. 41.

ANNUAL OUTPUT: OVER 85 MILLIONS OF CIGARS.

CIGARETTE FACTORIES:

LEGITIMIDAD,
HONRADEZ,
HIDALGUIA,
} (Marques Rabell), Paseo Carlos, III.

CORONA, (Alvarez & Lopez), Amistad No. 146.
FIN DE SIGLO, Reyes Street No. 3.

AGUILA DE ORO, Bock & Co.,)
HENRY CLAY, (Jul. Alvarez.)
ESPAÑOLA, (Fueyo & Co.,)
EL COMERCIO, (Miguel Cusi,)
} Princesa No. 1, 3, 5.

ANNUAL OUTPUT: OVER 1160 MILLIONS OF CIGARETTES.

HABANA
Direccion General,
Calle de Cuba núm. 37.

LONDON
Office, Dashwood House,
New Broad Street No. 9.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-seventh year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: " Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

Vol. XXVII., No. 3. Sept., 1901. Whole No. 99.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

VOLUME XXVII.

EDITED BY L. S. VAN DUZER.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

The writers only are responsible for the contents of their respective articles.

CONTENTS.

The Lord Baltimore Press
THE FRIEDENWALD COMPANY
BALTIMORE, MD., U. S. A.

THE PROCEEDINGS

OF THE

UNITED STATES NAVAL INSTITUTE.

Vol. XXVII., No. 3. Sept., 1901. Whole No. 99.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE COAST IN WARFARE

By LIEUTENANT-COMMANDER JAMES H. SEARS, U. S. Navy.

The material for this paper was largely gathered at the Naval War College in the shape of notes, which were drawn from many authorities to be found in the splendid professional library of that College. Quotations have been liberally resorted to and much of the text must, in addition, be credited to the numerous authors consulted. Originality has not been sought; on the contrary the effort has simply been to assemble in convenient form some of the best thought and opinion concerning a somewhat obscure and controversial subject.

The writer wishes to acknowledge the great assistance afforded by Lieut. B. W. Wells, Jr., who besides revising these notes supplied many suggestions that have been included.

PART I.

"War can be defined: The supreme appeal of right against the force which denies this right; whence the highest objective of war; to do the enemy the greatest possible harm. . . . If a

great king, philosopher and master of the art of war declares that riches are the sinews of war, all that strikes the enemy in his riches, à fortiori, all which attains this object even in the sources of his riches, becomes not only legitimate, but obligatory. We may expect therefore to see the battle fleets, mistresses of the sea, turn their power of attack and of destruction, lacking adversaries worthy of their steel, against all the cities of the Littoral, fortified or not fortified; peaceful or warlike; to burn them, to destroy them or at the least to bleed them without mercy. Through this new rôle and these new missions that logic imposes on battle fleets, we are about to enter into a new system of maritime war; that of the attack and defense of coasts."

This extract from the writings of a distinguished French writer, the founder of a powerful school of naval thought which has for a period profoundly influenced naval construction and which is still weighty in that direction,—whether it can be accepted or not, strongly draws the attention of naval people to a form taken by maritime warfare, a study of the peculiar operations of which has not been widely prevalent. In the body of the work from which the extract is taken, the assertion is flatly made that the probability exists that coast warfare and the guerre-de-course will be the main features in future maritime wars. To those who are at all familiar with the naval literature of the last hundred years, this modern statement comes as a reiteration of a traditional policy in naval warfare of the writer's nation, and will be readily recognized as an old friend; to subordinate the contest for the dominion of the seas to the procurement of ulterior objects; in other words the seeking of the object directly, disregarding the objective, the enemy's fleet, the destruction or dispersion of which, places that object at once in the hands of the victorious fleet. The statement is based upon a resumé of the operations of our Civil War; upon the absence of naval engagements in the Franco-Prussian war in 1870-71, and in the Russo-Turkish war.

It is assumed that the inferior naval power will shelter its fleets under fortifications, and that naval supremacy will, à priori, be at once established. It is sometimes, and in some quarters, taken as indicative of the same end that land warfare exhibits a tendency to return to the form of what has been called wars of position or of posts, as distinguished from wars of

marches,—such a warfare for instance as our War of Independence became towards its close. If the distinction exists upon the sea, then the coast warfare may be likened to the war of position,—and yet wars upon land are not characterized by a wholesale wanton destruction for ransom. The future of maritime war is dark and is fraught with tremendous possibilities, and it is best to acknowledge the permanence of coast warfare as a contingent or an integral portion of war upon the ocean,—not a thing of modern development, as the author assumes,—but it is not at once apparent that the conclusion is supported by sufficient grounds or argument. The undoubted facts derived from the wars used as examples, as in many other cases, may be used to support conclusions differing somewhat from those drawn. The error usually made in regard to the guerre-de-course of our Civil War is repeated by the author. The coast warfare during that struggle was called into existence by conditions happily, in our case, most unlikely to recur; and, in the Franco-Prussian war the contact of squadrons, the marine battles, were absent through a great complexity of causes, the course of the tremendous struggle in France most profoundly influencing the action or, more accurately speaking, the inaction of the fleets of the two nations. Not the least among the causes was the embargo placed by the Prussians upon their merchantmen in all parts of the world, thus removing largely any necessity for their inferior squadrons to keep the sea. A most significant fact connected with the wars in question and with the other wars of recent times, especially with the Crimean War, is that coast warfare either took place in the beginning, on the coasts of the power whose naval force was inferior to the point of impotence, or after that naval force had been reduced to impotence. Also, it is significant that there has been a marked abstention from acts of destruction or threats of destruction for the purpose of securing ransoms. In the Crimean War the question of fixed and mobile harbor defenses cropped up in England, but before long people recognized that the English coast line was being protected in the Baltic and Black Seas, and so the question lapsed. The northern coasts of this country from 1861 to 1865 were also secured by the blockading fleets on the southern coasts.

In the Franco-Prussian war we have the spectacle presented of

a French ironclad squadron hovering over a number of inadequately fortified German ports in the Baltic and North Seas, and yet not striking a blow. The reasons for this inaction were good and imperative, and they are just such reasons as may be again presented for the consideration of naval commanders.

In the civil war in Chile in 1891, the utmost pains were taken by both sides to secure the objectives without bringing ships and fixed defenses into competition. In our Civil War, it became axiomatic that ships alone could do little more than temporarily silence defenses, or run them in unobstructed channels. The active operations were secondary to those of the land forces in nearly every instance, and it must be remembered that the southern coast defenses were frequently defective and scantily garrisoned.

The great powers are actively engaged in placing their maritime frontiers in a state of more or less humanly perfect preparation and each nation is becoming more and more like an entrenched camp. Coincident with this is the fact that the evolution in naval architecture is less and less in the direction of fitting vessels to cope with modern coast defenses, except for a very recent tendency to return to the system of a wider distribution of armor and the growing importance attached to the medium or secondary armament, the prominence of which in most modern vessels is very much in evidence. The draft of vessels is great and it is assuredly a fact that vessels are not designed nor built with a view of attacking fortified positions. The tactical questions that force themselves for consideration in the design of ships relate to contests between ships and between squadrons, and this, in spite of the fact, that the armor idea, though an old one, began its real development, in the Crimean War and sprung from a desire to fit ships to withstand the terrible horizontal shell fire, which at that time was a novelty and which stands in mild comparison to the high explosive shells of to-day.

Fortifications as opposed to ships, have the lee gage certainly, but they have all the advantages of the defense in being prepared on the spot and for the one particular purpose which called them into existence. Fortifications will be attacked no more frequently in the future without the most careful and studied preparation and special appliances than they were in

the past; and if the duration of war has decreased, the time necessary to replace a battleship has vastly increased. The enormous value of a battleship will make its loss severely felt, and for this reason the risks will be greatly enhanced. As far as fortified positions are concerned, the power contemplating an attack upon them will be weighted with as grave considerations in the future as in the past. Such an attack, with or without the cooperation of land forces, has never been held other than as an extremely hazardous and delicate operation, warranted only by the magnitude of the material results to flow from its successful issue; while, on the other hand, the risks and losses in case of an unfortunate outcome have been equally taken into consideration. The successful squadron has been lauded throughout the world, even when the defenses and defenders have been of the most ignoble character; and it is another significant historical fact, worthy to be borne in mind, that the attacks of ships unsupported by landing forces in nearly every instance have been directed against the forces and the works of peoples far lower in the scale of civilization or preparedness than the attacking party.

In the present day, it may be said that the methods of attacking modern fortifications have scarcely been considered or tested. Other tactical problems have received more or less attention, this one but little, and it may be surmised that a squadron attempting such an attack will be obliged to submit to a very crucial test. Few seaports, if properly fortified, are of such importance that the reduction of their sea fronts would produce results commensurate with the risks undertaken by a fleet in making a direct attack. On our own seacoast, for instance, can it be stated that the possession by an enemy's fleet of any one port would be sufficiently decisive to warrant the exposure of a fleet of battleships to the certainly great losses it must suffer in the presence of modern fortifications, if operations of another character were open to it, and a hostile fleet still in existence? There may be a time in the course of wars when the balancing of advantages and risks will warrant such an undertaking. The opinion is not expressed that such operations will not be undertaken, but only that there is little to justify a belief that they can often produce decisive results, or will be resorted to more freely than heretofore. Concerning this aspect

of the subject, a Frenchman of another school justly says: " But let us suppose that the defense is decidedly inferior to the attack. In case of war between France and Italy, would the laying in ashes of Leghorn, Genoa, Palermo or Naples put the whole of the latter country at the mercy of the first? No, a thousand times no! no more than the ruin of Bordeaux, Havre, or Marseilles would force France to lay down her arms in the struggle for her existence. For, let it be remembered, a merciless war has this peculiarity: it inspires the weak with courage, a desperate courage, and not only courage, but a savage hatred and a thirst for revenge, from which several future generations will suffer."

Bases are essential to the operations of fleets, and it may be that bases in proximity to their fields of operation have acquired a new importance in these days of steam, for certainly battleships are not expected now-a-days to keep the sea in the manner of the old three-deckers. If the problem of coaling at sea be solved, there still remains to be considered the rapid deterioration of material due to mere complexity. But, in order to establish bases, fleets will not choose to attack strongly fortified positions, nor will it be to their interest to destroy the resources of the position occupied;—and it is not at all clear why fleets should put themselves into competition with formidable fortifications until, in combination with an army of invasion, a telling and decisive blow can be struck. A maxim of Napoleon's is worded thus: " Never do what an enemy wishes. One ought therefore to avoid the field of battle which he has studied, and as a consequence never attack in front a position which can be gained by turning." This maxim seems to be especially applicable to operations such as are under consideration, and its truthful bearing is borne out by the facts and experiences of all naval wars. A study of Admiral Colomb's writings on naval warfare should certainly establish its application in the mind of everyone, when direct operations against a fortified point are under consideration.

The *Army and Navy Gazette* of August 20, 1892, contains an extract bearing upon this point, as illustrated by the attack in the manoeuvres of the same year upon Belfast harbor and the works inside. The defenders were far inferior in numbers and in the matter of defense vessels, but the mine fields covering

them were very extensive and laid in double lines. The mine fields were also covered by flanking guns and search lights. The extract reads: "Considering the nature of what may be termed the second phase of the war, this result (referring to the large number of the attacking vessels claimed to have been put out of action) is not, perhaps, surprising; for it is extremely probable that in just such operations in actual warfare will the loss on both sides be very heavy. A question of importance is thus at once raised, is it expedient to engage in such operations as those which Admiral Fitzroy attempted, looking at the limited nature of the advantages likely to accrue from the ultimate success of the force undertaking the offensive, and the risks involved? In other words, is the game of attacking ports defended in the manner Belfast was assumed to be, worth the damage which the attacking force will probably sustain?" The action and condition of the inferior squadron were of a nature that can well be repeated when the manœuvres are not peaceful, and in one sense they are very pertinent to the subject of coast defense, and the line of strategic defense best calculated to insure coast defense. An inferior squadron was interposed between two detachments of the superior squadron. It is a very old situation—what the inferior squadron did in Belfast is well known, and the decision was against it. Without questioning the propriety of the attack made by the superior fleet, it may be useful to inquire if the Admiral of the inferior squadron did what was best for the one narrow and perhaps not vital issue—the defense of Belfast. The issue is here raised as to a point which will be referred to again. Rather than meet one detachment with the chance of disaster to himself, together with the certainty of inflicting great damage to the enemy's detachment, he placed his fleet in the position of a harbor defense flotilla. The question raised is one of policy. Is it wise to build with a view to such a defense, or to build with the view of defending the coast in another manner? It is not suggested that the defenses may not be materially strengthened by the presence of powerful vessels of types especially fitted for harbor defense; in many waters they may be invaluable,—but which shall we have first? The harbor defense vessel stands for so much naval strength; its value is taken from the total appropriation, and the line of battle is thereby weakened. Is there not, then, a minimum

naval strength which we should seek to attain,—a strength that would enable us to make an attempt at the naval defense which, historically considered, is deemed the best? That strength once reached, it then would be time to consider the question of the propriety of building such vessels. The opinion first quoted, which seems to have been rather generally entertained, goes farther towards clearing up the point as to the need of local protection by vessels when conditions are favorable for fixed defenses.

De Ruyter's action at Solebay, when his general position was not unlike the mimic one of Admiral Fitzroy, strategically considered, is worthy of being borne in mind. His squadron was inferior and his action was dictated by an immediate necessity for guarding the coast. Concerning it, and the results flowing from it, Captain Mahan says: "The allied fleets were to have assisted the operations of the French Army, by making a descent upon the coast of Zealand. De Ruyter's attack had inflicted an amount of damage, and caused an expenditure of ammunition, which postponed the sailing of the fleet for a month. It was a diversion not only important, but vital in the nearly desperate condition to which the United Provinces were reduced ashore. It may be added as an instructive comment on the theory of commerce destroying, that after this staggering check to the enemy's superior forces, de Ruyter met and convoyed safely to port a fleet of Dutch merchantmen." Captain Mahan further says concerning the general subject of the war: "For the allies to carry out their objects, and make any diversion upon the seaboard, or on the other hand, to cripple the sea resources of the hard pressed Provinces, it was necessary first to deal successfully with de Ruyter's fleet. The great Admiral and his government felt this, and took the resolution that 'the fleet should be posted in the passage of Schoneveldt, or a little farther south towards Ostend, to observe the enemy and, if attacked, or seeing the enemy's fleet disposed to make a descent upon the shores of the United Provinces, should resist vigorously, by opposing his designs and destroying his ships.' From this position, with good lookouts, any movements of the allies would be known. . . . After La Hogue, the direct military action of the allied navies was exerted in three principal ways; the first being in attacks upon

French ports, especially those in the channel and near Brest. They had rarely in view more than local injury and the destruction of shipping, particularly in the ports whence the French privateers issued; and although on some occasions the number of troops embarked was large, William proposed to himself little more than the diversion which such threats caused, by forcing Louis to take troops from the field for coast defense. It may be said generally of all these enterprises against the French coast, in this and later wars, that they effected little, and even as a diversion did not weaken the French armies to any great extent. If the French ports had been less well defended, or French waterways open into the heart of the country, like our own Chesapeake Bay and Delaware Bay and the Southern Sounds, the result might have been different."

Concerning this particular point raised in the last paragraph, it is well to note here, the prominent place which must be assigned to the navy in coast defense. These very waters perhaps are entirely indefensible by fixed defenses. Without a navy, they may in the future become, as in the past they did become, the scenes of war. The introduction into warfare of elements different from those existing at the time treated of by Captain Mahan, has placed other localities in the same category. Formerly, the occupation of the Lower Bay at New York was not a distinct menace to the interests above and beyond; the defense was good at the Narrows. To-day the defense should be pushed to the outer limits.

This Dutch war, the third great one of the 17th century, contains so many elements directly bearing upon the subject, that it will repay closer investigation. Considering the short space of time in which it took place, the restricted area covered by the operations, and the fact that the objectives of each side were not obscured by a mass of outside details, it is perhaps one of the best examples in history of how a navy, though an inferior one, accomplished the greatest good in national defense. There is no question of the character of the weapons used, nor of the tactical combinations developed, in the presence of the enemy. The valuable lesson is quite independent of all such considerations, and is to be found simply in the strategic uses of armed forces. Four great battles were fought, not one of them being deemed by contemporary English historians a vic-

tory in the ordinary tactical sense, and yet the Dutch fleets saved the nation. The whole course of this war bears testimony to the place of a navy in coast defense which it is impossible to disregard.

The French invaded Holland with 200,000 troops and were opposed with but 20,000 backed only by an inferior navy, diplomacy, and the dykes. The greatly superior naval force of the English and French in the four great drawn naval engagements was prevented from landing the troops and ravaging the coast through the desperate courage and the skill of the inferior Dutch fleet. The last battle, which took place off the Helder, was within a few miles of the shore and in the hearing of the people. Concerning this battle the contemporary English historian Ledíard naively says: "The Dutch made pretenses to the victory this time, with such assurance that they had publick rejoicings and thanksgivings on that account, and de Ruyter was, on this occasion, complimented with the title of Preserver of his Country. This latter may, indeed, in some measure, be said to be justifiable, because he had preserved his country from the intended invasion of the English: and if it may be called a victory, because the English were prevented in their intention, which, indeed, is the chief reason they ground their pretense to it upon, they are not altogether in the wrong; but for any other advantage it is apparent they had none."

The first battle, that of Solebay, was fought in June, 1672, with the one great result that the designs of the allies against the Dutch coast suffered a check. How was it in Holland itself? The biographer of de Ruyter tells us that the news of the battle was received two days later at the Hague, that in the beginning of June the land frontiers were attacked simultaneously in all parts by the three armies, the French, that of the Elector of Cologne, and that of the Bishop of Munster. The Dutch waited for news that the French had taken Utrecht and had penetrated to the heart of Holland. The greater number of the officers were without courage and without experience, the soldiers were seriously deficient in both qualities. Order was lacking, negligence was extreme, and dissensions were augmented. Moreover, an extraordinarily dry season had converted the great rivers, the natural ditches to the Dutch fortresses, into fordable streams, and the marshes and swamps that surrounded

many fortresses had become dry and hard,—Heaven and Earth seemed to conspire in every way to cause the downfall of a nation. Believing the time had absolutely arrived, and being strenuously urged by Pensioner de Witt, the people were disposed to use the means which they kept in hand for the last extremity, to raise the sluice gates, submerge the country, and concentrate every resource in Amsterdam for a last desperate defense. "Such was the state of affairs and dispositions of men's minds when the news arrived of the issue of the naval combat against the armies (naval) of the two kings. People were then compelled to acknowledge that the Providence of God had used these measures in order to preserve the Republic, for if the English and French together had been as happy by sea as the latter were by land, and that if the fleets of Holland had been beaten, there is no possible doubt that all would have been lost." Such was the influence of the first drawn naval battle. The French successes continued on the land frontier, and Utrecht and Naarden fell. All the Dutch commerce had been embargoed. The sluice gates were opened, and the country was now stripped for a death struggle.

De Ruyter studied the coast, searched out the places where a descent would be practicable, reinforced garrisons, and posted his fleet well inland and in a position to take every advantage as the opportunity offered. A council of war, convened by the Prince of Orange on his flagship, determined "with one voice that the fleet should remain at or near its present position (Schoneveldt)." One year after the battle of Solebay, de Ruyter put to sea in the presence of the superior allied fleet, and another drawn battle was fought. The biographer says: "It is certain that on one side the object at least was a descent on Holland or Zealand, and the destruction of the Dutch fleet if possible, on the other side the attempt was only to defend themselves, and to guarantee the coasts against invasion." This was certainly the result of the drawn battle. One week later de Ruyter put to sea and fought until after dark, and then reformed his fleet and headed N. W. to keep touch with the allied fleet,—but the next morning that fleet was not to be seen. The allies returned to the Thames, and de Ruyter to his post off the Schoneveldt, whence he declared to the Deputies "That it was necessary to post the fleet in the most advantageous

quarter of the Schoneveldt, in order to cover the coasts of the Provinces from the invasion of the enemy." The French now besieged Maestricht so closely that de Ruyter was directed to sail in order to create a diversion either on the French or the English coast. Maestricht fell before he sailed, but the plan was carried out. The English fleet sailed from the Thames, and the two fleets manœuvred for days in sight of each other without coming to action until de Ruyter learned that the design of the English was to draw him away from the Dutch coast, while an army of invasion could secretly be thrown into the country; where he returned and cruised along the coast until August, when the last great drawn battle was fought off the Helder,—the English returning to England as usual, and de Ruyter to the Texel to refit.

Other countries had come to the assistance of Holland, and the soldiers on the coast were free to return to the army, Naarden was easily retaken, then Borne,—followed by the evacuation of Woerden, Bommel, Utrecht, and finally of all the provinces. Preparations were made cheerfully by the Dutch for a campaign in the following spring, but the English government under compulsion of the people consented to a peace. This is the story in few words of this famous war, and there is no possible question but that de Ruyter with his fleet saved the Dutch nation. Without crushing his enemy or even inflicting a defeat of magnitude upon him, de Ruyter absolutely gained his object and frustrated that of the allies. The coasts were saved from serious attack, no cooperation of the allied fleets with the armies on shore was possible, while de Ruyter remained afloat with a concentrated fleet. It is difficult to see how any question in the modern development of ships and weapons can operate to change our ideas of the powerful influence that even an inferior fleet can exert in coast defense or of the proper handling and disposition of naval forces in such defense.

Coast raiding, in whatever form it may take, is a different thing. The risks are small, the results considerable, and it will continue to be resorted to freely in maritime warfare Cruisers may act as commerce destroyers or raiders, according to which method of action gives the better returns with the lesser risks. At any rate, the cruisers, before being ultimately

destroyed, stand a good chance of paying for themselves. During the War of 1812, nearly the entire Atlantic coast and the Chesapeake Bay shores were subjected to ravage, and their coast villages plundered and burned. It may have paid, and the risks were certainly small, though no appreciable effect was produced upon the course of the war. The other operations on the coast were of the nature of coups-de-main which took no concern of fortifications, with the exception of the Baltimore affair.

The direct serious operations of a fleet upon a coast rarely have been regarded as having any decisive result upon the course of a war in which they form a feature, even though undertaken with all the guarantees that have been offered by the temporary or, even more far reaching, habitual command of the sea. Blockade of the enemy's vessels or his commerce, observation of the enemy, contact of fleets, or the support, transport, and sustenance of an army, constitute far more effectual and direct operations for a navy, and conduce more to accomplish the desired result.

The limited field of action of naval forces was well understood by Mr. Pitt, who, in 1794, in supporting the increase of the English land forces, subsequent to the failure of the Dunkirk expedition, said: "The power of Great Britain at sea, however irresistible on that element, could not, in the nature of things, make an adequate impression upon the enemy, whose whole strength was concentrated on land; and who, for that reason, could there only, be assailed with efficacy. It was only to prevent the invasion of the territories of their neighbors, that the war against the French had been undertaken."

This limitation of the powers of a fleet may have been one among the many causes of the failure of the English in the War of Independence. In the absence of a defensive flotilla, the Atlantic coast of the United States presents a theatre singularly favorable for the offensive action of fleets. The series of events in which Lord Howe and d'Estaing figured between New York, Newport, and Boston is too conclusive to be lost sight of as to the influence of a flotilla on the defense in preventing territorial attacks, and as to the relations existing between fixed and floating defenses.

Leaving the Delaware on June 28, 1778, Lord Howe arrived off Sandy Hook on the day following and was met by a

packet express from England, the Grantham, with the intelligence, dated May 2, of the departure from Toulon on April 13, of a squadron destined for American waters,—and, also, that his own fleet would be reinforced by Vice-Admiral Byron with thirteen vessels, which force sailed from England for Halifax on June 12. The British government acting upon the information of the sailing of d'Estaing had directed Sir Henry Clinton to evacuate Philadelphia, and after accomplishing the evacuation, he reached the Jersey Highlands on June 30, with the Continental army hanging close upon his rear. Howe extended every aid to get the army on to the Hook and thence to New York, and accomplished the transfer by the 5th of July. The vessels from New York under Commodore Hotham joined the squadron on the 7th, two days later, and at this time Howe by a letter of marque received positive intelligence that the vessels of d'Estaing's squadron had been seen off the Virginia coast, and later at anchor in the Delaware. Still later it was known that d'Estaing was approaching New York, the force under his command consisting of twelve sail of two decks and several frigates. The vessels were, one of 90, one of 80, six of 74, three of 64,—the smallest frigate carrying 36 guns. The total complement was about 11,000 men, of whom 1548 were soldiers. At noon on the 11th, a lookout frigate signaled the news of the anchorage of the French off Shrewsbury Inlet, about four miles below the neck of the Hook. Lord Howe's total force consisted of six sail of the line of 64, three of 50, two of 40, with some frigates and sloops. The cause of d'Estaing's appearance is to be found in the battle of Germantown and in Burgoyne's surrender, which turned the scale in the wavering minds of the French,—and as a result, the treaty of alliance was signed February 6, 1778. On the 15th of April, 1778, d'Estaing sailed from Toulon and on the 8th of July he reached the Delaware capes. It has been said that his time was unnecessarily slow, but it does not appear that this opinion is wholly justified. Four weeks were occupied in reaching the straits, leaving eight weeks for the passage across the Atlantic. Vessels now-a-days at that season of the year, sometimes take as much time, and the speed of a fleet is regulated by that of the slowest element. Nelson's average speed in pursuit of Villeneuve was but three knots per hour. At that rate,

d'Estaing would have taken sixty-one days, and Chevalier states that two of d'Estaing's fleet were such poor sailers that they kept the whole fleet back. The four weeks between Toulon and Gibraltar was also a matter of not uncommon occurrence.

On the approach of the French fleet Howe was busily engaged in preparing for sea, with a view to forming a junction with Byron, or to be ready for any emergency. Lookout service was efficiently performed by volunteers in light draft coasting vessels. A considerable part of the fleet, including the flagship, was at Staten Island taking in water, when the news was received of the proximity of the French. Howe at once proceeded in his barge to the Hook, expecting that d'Estaing would not hesitate an instant to avail of what seemed to him a great opportunity thrown in his way of overhauling a detachment of the British fleet at anchor. D'Estaing in the uncertainty caused by the doubts of his pilots, who were the best on the coast, passed several days in sounding the bar; and this gave a breathing spell to Howe, of which he made good use. Howe caused soundings to be made and the currents studied, and he made the most careful and skillful preparations to receive an attack however delivered. The British fleet was moored head and stern, concave to the channel of entrance around the Hook,—the gap nearest the extremity of the spit being filled by an armed transport, the Leviathan. On shore two batteries, one of two howitzers and the other of three 18 pounders, were thrown up on the prolongation of the line, and four regiments under Colonel O'Hara were landed to dispute any possible attempt on the part of the French to land. The other extremity of the line left perhaps the space of a mile between it and the S. W. spit. Some frigates were held in rear for incidental service, and a double line of frigates and rowing gun vessels was thrown forward towards the bar. The outer line was to receive the first of the attack and undertake to throw the French into confusion. The inner line was to fight under oars, and gradually to withdraw over the shoals where it could not be approached by any but the smallest vessels. The vessels of the line at anchor were moored with their heads towards the Hook, and the moorings on the port quarters would enable the broadsides to be sprung in every direction that the channel would permit the enemy to take. No possible improvement

would seem to suggest itself upon Lord Howe's arrangements. His line could not be pierced; and could only be doubled at the inner end, but not until after the enemy had been under the continued concentrated fire of every vessel in the three lines and the Hook batteries. On the 22d, five days only before the battle of Ushant, d'Estaing weighed in a fresh N. E. breeze at 8 A. M., and reached to windward, apparently with the object of obtaining a weatherly position for entering. In the afternoon, the spring tides running, the water was thirty feet on the bar. At 3 P. M. the French fleet had borne up to the southward. It was supposed that d'Estaing had not abandoned the attempt, but fearing an easterly gale in an exposed position on a lee shore, had put to sea for room. In the next few days, the vessels of Byron's squadron which had been dispersed in a gale began to arrive, and, of course, in the absence of the French they went to the reinforcement of Howe.

It is but fair to let d'Estaing speak for himself of his failure to crush the squadron of Howe:

"Both officers and crew were kept in spirits . . . by the desire of delivering America from the English colors, which we saw waving, on the other side of a single barrier of sand, upon so great a crowd of masts. The pilots procured by Colonels Lawrence and Hamilton (under Washington's direction) destroyed all illusion. These experienced persons all unanimously declared that it was impossible to carry us in. I offered a reward of 50,000 crowns to any one who would promise success. All refused, and the particular soundings which I caused to be taken myself too well demonstrated that they were right."*

Howe received information of the appearance of the French before Newport and of their dispositions in the three entrances to Narragansett Bay, by which he was encouraged to believe that he could oppose his force to detachments of the French fleet. Wind and tide however not making favorably and together, it was the 6th of August before he got away from New York, and the evening of the 9th before he reached Point Judith, where he anchored. The lookout frigate reported the enemy at anchor inside, the entrance having been made under the fire of the shore batteries on the 8th. By way of Brenton's

* d'Estaing to Congress.

Point, Howe received exact information of the enemy's dispositions. D'Estaing had arrived off the harbor on the 29th of July, and had sent two ships in by way of the western passage, which passage they forced under a crossing fire by batteries on the southern extremity of Conanicut Island, and the western shore, at Bonnet Point. The successful entrance of these vessels caused the abandonment of the batteries on Conanicut Island, and the burning and sinking of vessels in the harbor, mounting in all 212 guns. It was, as before stated, only on the 8th of August that the main fleet was taken inside under fire, and on the next day 4,000 sailors and soldiers were landed on the upper part of Rhode Island to augment Sullivan's forces of 10,000. The entrance of the fleet also caused the English to narrow their lines of defense and concentrate above Newport.

When Howe's fleet was reported to d'Estaing, he recalled his 4000 men, and on the 10th with a wind fair out of the entrance sailed with his whole force. Howe's biographer, Barrow, states that at this juncture, the British fleet was superior by 12 guns, but that the odds in weight of metal were against it and in favor of the French. It was Howe's opinion that he could not venture to attack the French within the harbor; and if we recall the situation in front of New York, where d'Estaing confronted a sand bar, and every gun hostile, and contrast it with the position at Newport, with plenty of water and the batteries of one shore friendly, it will perhaps appear that Howe escaped condemnation in his turn only by the sally of the French. Outside, both fleets were terribly handled by a gale and dispersed without coming to a decisive engagement,—Howe's fleet being reunited at Sandy Hook, while that of d'Estaing returned once more to Brenton's point on the 20th of August. Learning of this fact, Howe made all sail to come up with him, but the bird had flown, and on the 1st of September Howe got sight of him anchored in Nantasket roads, and well disposed for defense under batteries thrown up on friendly islands. Again the opportunity to attack is foregone, the position of the French being deemed one of great strength. Before the English were strong enough to shut up the French they got away in a snow storm for the West Indies, and Sullivan had withdrawn from Rhode Island.

In this series of operations,—all occurring directly on the coast line and therefore more closely marking the intimate rela-

tion between coast defense and a mobile force than when operations in the open sea are carried on, although coast defense may be none the less secured by such actions,—we see a fleet three times posted under fixed defenses awaiting an attack which for tactical reasons is not delivered. Tactical lessons, then, from these situations can only bear upon the various dispositions for defense that were introduced. In another sense however there can clearly be seen indications of value in some respects as to how a fleet can best be used to promote either coast attack or coast defense. Let us put plainly before us the military situation on the coast. The threat of d'Estaing's force had compelled a concentration of the British at New York. Rhode Island was also held by the English, while Boston was and had been American. In the time of these movements as described, then, the English were strictly on the defensive, while the designs of the Americans supported by the French Fleet and soldiers were strictly offensive.

D'Estaing's orders contemplated a general support of the American armies, but first of all, aided by secrecy he was to fall upon Howe's inferior fleet and transports in the Delaware. Paul Jones in a memorial had urged this action on the Court of Versailles previous to d'Estaing's departure. The evacuation of Philadelphia may be taken as a sign of a feeling of weakness in the English ranks, and if d'Estaing had come up with Howe either in the Delaware or at sea, it is more than likely that Howe, encumbered and inferior as he was, would have been beaten, and in consequence New York, invested on all sides by Washington's army and the French fleet, would have fallen. D'Estaing's arrival being too late for this decisive action, Washington left it to d'Estaing whether to cooperate in the attack on New York or on Newport. Washington planned to act upon the choice of either, and prepared for the augmentation of Sullivan's army in Rhode Island by raising militia which he was empowered to do, and by holding regulars in hand to be sent overland from about New York, the water passage though desirable being dangerous because of the English cruisers.

When d'Estaing determined to abandon the attempt on New York, there remained open to him two alternatives in the use of his fleet: to proceed as he did or to block up Howe's fleet in New York Bay with his whole fleet or a portion of it, detaching

the remainder for the reinforcement of Sullivan or for the purpose of informing Sullivan of his predicament. Finding Howe so strongly posted, the strategic situation had materially changed from the conditions under which Sullivan had been induced to look for the French assistance. Was the American cause better furthered by holding Howe impotent and with a chance of overcoming him, or by proceeding to the aid of a territorial attack, not yet fully concerted, which was certain to be interrupted by what has always been sufficient to interrupt such attacks,—even an inferior fleet? The dilemma of d'Estaing was aggravated by the fact that though aware of Byron's approach, he did not know of the dispersed condition of his force, and, feared to be caught between two hostile fleets off New York,—yet the key of the whole situation was one or the other of these fleets, or both. By informing Sullivan and holding Howe he could by means of lookouts have had ample news of Byron's condition and approach; and by having observing vessels in front of New York, Byron could have been dealt with. By leaving New York, d'Estaing surely invited the course of events which followed, and deliberately abandoned the one chance of success. Howe's great personal energy and the good will of the whole fleet, enabled him, by simply appearing before Newport, to save the place,—and the pages of history are full of records to the effect that a territorial attack is powerless until the interfering naval force is disposed of. When Howe appeared, it was imperative that d'Estaing should embark his 4000 sailors and soldiers, and then he was in the same position as when before New York, with the exception that Howe was at sea with about an equal force and did not intend to lose touch with the French, but to require the final settlement to be between the naval forces. D'Estaing here, it seems, seized the right conception, but if there had been a battle and d'Estaing victorious, Howe's use of the inferior force would still have saved Newport or at least gained time, for d'Estaing's condition would undoubtedly have forbidden the immediate prosecution of the designs against Newport, (the injuries caused by the gale having forced him to go to Boston to refit) and the English government would have been fully aroused to the need of augmenting the forces on the American coast.

D'Estaing left for the West Indies, eventually, under the threat of the now superior English forces.

The advantages conferred by his visit are thus stated by Chevalier: "The attitude of the Versailles cabinet had called the attention of the English ministry to the dangers to which Howe was exposed, and in giving him orders to leave his position the Court of London had been obliged to decree the evacuation of Philadelphia, since Clinton's army could not sustain itself without the fleet: it is therefore exact to say that this result was entirely due to the French alliance. . . . The arrival of Lieutenant General d'Estaing had, while increasing the confidence of the Congress in the ultimate success of the insurrection, deprived the English Commissioners of all hope in their mission. The corvette Stanley, the corsairs Rose and Fanny and eighteen merchant vessels had been captured by our ships. The York sloop had fallen into our hands, but was retaken by the English. The Mermaid frigate of 28 upon the point of being engaged by the Fantasque and the Saggitaire was wrecked upon the coast on the 8th of July at the mouth of the Delaware. At Rhode Island, the Grand Duke frigate of 40, the Larck, Juno and Flora frigates of 32, the Cerberus of 28, the King Fisher and Falcon corvettes and other smaller vessels were burnt or sunk by the English. The Senegal corvette, and a bomb vessel were captured by our frigates subsequent to the gale of the 11th of August."

In October, 1779, the British evacuated Newport under the threat of d'Estaing's reappearance upon the coast, and concentrated for the defense of New York. Previous to the evacuation Washington wrote to d'Estaing: "Success in this attempt (upon Rhode Island) would be favorable to our ulterior operations against New York, but a failure would be attended with the reverse, as it would damp the spirits of the country and diminish its exertions. Another inconvenience would attend it, which is, that, without a division of your force to continue the blockade of New York, the fleet now there would make its escape. Indeed, in any plan a division would be indispensable. Rhode Island and the Sound must be blockaded otherwise the garrison there will form a junction with the main body at New York, which would be so great an accession of force, as would render the success of our operations impossible. . . . In case of the attempt upon Rhode Island, the only expedient to avoid a division of your ships of the line, will be to remain with the

whole at New York, and send your troops around under protection of your frigates." There existed no practical difference in conditions to have rendered this advice less applicable fourteen months earlier than it was when it was written.

Opinions differed in former days as to the use of fleets, and an officer who accompanied the expedition of Ross and Packenham which burned Washington and was beaten at New Orleans, afterwards wrote a book in which some tactical opinions appeared. These opinions gained considerable vogue and were skilfully used to support the doctrine of the efficacy of coast warfare. The author says: "To penetrate up the country amid pathless forests, and boundless deserts, and to aim at permanent conquests is out of the question. America must be assaulted only on her coasts; her harbors destroyed; her shipping burned, and her seaport towns laid waste, are the only evils which she has reason to dread; and were a sufficient force embarked with these orders, no American war would be of long continuance."

No one is inclined to question the fact that steam and the development of speed and long range ordnance have conferred a great power of offense upon vessels by enabling them to take the sea quickly and fall suddenly upon various points of the coast line. Cruisers are especially adapted to such a warfare. They can appear before ports without warning; they can commit what depredations they choose, or they can levy a heavy ransom. Their long range ordnance will be effective against exposed mercantile ports, while they themselves enjoy considable immunity. So long as they retain their speed and keep their coal bunkers full, they have little to fear. It is however, open to grave question whether steam with its numerous advantages has made the maritime siege of a seaport any the easier in execution or more certain of success than was the case in the days of sail. In those days serious attacks upon fortified positions were made only after due preparation, the attacking force and its accessories being properly proportioned to the contemplated operation. The preparation once completed, however, the fleet was able to maintain itself in position for a considerable period with no great difficulty, even though the contingent base was not close at hand in point of time. The necessity at present for greater care, in the expenditure of ammunition, owing to the relatively few rounds carried, and the

rapidity with which it can be exhausted, does not lessen the comparative difficulties in such operations.*

Coast warfare has always accompanied maritime warfare, and as the relative powers of navies engaged in such wars have varied in the past, as in the present, no argument can be drawn from the tendency nowadays towards an equalization of the strength of navies or towards the supremacy of one or more navies.

The question of coast defense is a vital one to any maritime power, or to one with a maritime frontier. The expenditures required to fortify a coast properly, are enormous; and this fact alone demands that the subject shoud be carefully studied, that the expenditures may be properly applied. There is no theory so false as the one that calls for the utilization of means or schemes, however effective, without regard to cost; for upon that theory, the revenue of a government might be wasted in arming the coast at all points. It is true, the coast might be protected, but it would not be any the better protected than by a system founded upon the study of the needs of coast defense, and it is needless to say that no government with such a coast line as our own is rich enough to enter upon such a course. If it were a matter of demonstration or experience that a continuous front of defenses on the coast or at every opening, would guarantee its integrity, it might be well to adopt that line as a standard, were it in any degree within the range of possibility to completely develop it. But such is not the case.

In a few respects there is considerable likeness existing between a land front and a seacoast. The land front *may be* a natural line of defense; the seacoast *is* a natural line of defense. Continuous lines of fortifications on a land front, strengthened at strategic points, have long been abandoned,—they could not be held at all points, and never fulfilled the expectations to which they gave rise. Were it within the limits of possibility to provide every opening in the coast line with fortifications,

* At Alexandria, the ammunition of the English vessels ran dangerously low, especially that of the Sultan, which was reported to have been within an hour of complete exhaustion. The bombardment would have been an impossibility, if there had been any chance that the fleet might have had a mobile, even though inferior force, to encounter afterwards.

the enemy could, from the impossibility of garrisoning every such point, land upon the coast and open the way by a coup de main;—and we cannot too often recall the experiences of the Southerners who, at the expense of the armies in the field, made the attempt to furnish every available port of their coast line with fixed defenses and garrisons.

Frequently for military purposes a seacoast has been compared with a mountain range which can be passed at a few points only, the remainder of the front being generally impassable. The passes and harbors are strategic points, and indicate clearly the locations for fortifications. In the case of a mountain range, the passes are few, and the enemy is compelled to attempt them unless they can be turned. On a seacoast such as our own, the roads are many, and it is conceivable that the objects sought in coast defense are different, while there may exist also a wide difference in the objects to be obtained by coast defense by the various nations. These objects themselves are distinguished, one from another, by two distinct sets of considerations, one depending upon the nature and composition of any probable attack; the other upon the best means of defense available, flowing from the condition or state of the nation which would cause one method of attack to be the more easily repulsed than another. For instance, the form of attack known as invasion cannot be contemplated by Englishmen with calmness; whereas, there is no country where invasion could be so surely repulsed as our own, and where it should be so little dreaded; and if the attack upon our arsenals, wealthy cities, and other strategic points can be made to assume, on account of fortifications, a risk not commensurate with the results even in case of success, then it seems that the mission of seacoast fortifications will be fulfilled. The attack being averted, the enemy will be forced to let his offensive operations take some other form, blockade perhaps, or invasion. The first can be interfered with *only by a navy or the mobile defense*, while the second cannot be prevented in the beginning, but can be made disastrous to the force undertaking it; and neither can be seriously undertaken *while a navy is in existence free to act in opposition.*

Since 1826, it has been constantly asserted in some quarters that war could only be excluded from our territory by fortifications, and that we could only assume the offensive through our

navy; but it is not certain that there is anything in history to show that seacoast fortifications ever excluded war from territory, while history is replete with examples to show the influence of a navy in that direction.

In another sense, the dread of invasion of this country should not bear very heavily upon us, with but one nation bordering our own so closely as to render the operation in any degree easy of execution,—and in the case of England, the operation of invasion could be made to work both ways. Basing her power, however, on Halifax, Bermuda, Nassau, and the Antilles in the Atlantic, and upon Esquimault and Guadeloupe, perhaps, in the Pacific, she is sufficiently provided with contingent bases so necessary to the success of such an operation, or in fact to the success of any operation over the sea. The first requirement for extensive operations would be a base near the intended point of attack.

It is a singular fact that military or naval people have not yet determined with exactness the amount of tonnage required to transport a given army corps, with or without all the necessary equipage. For instance; for an army corps of 75,000 men, for a short trip across the North Sea or the Channel, the estimate of the number of vessels required for its transport is variously given as from 200 to 500, vessels of the same size being under consideration; and when regarded by tons per man, the estimate varies from three to five or six tons. It is sufficiently apparent, however, that for the transport of an army of invasion of the size absolutely demanded under the modern conditions which so greatly favor concentration for resistance, an enormous tonnage would be required even for a short trip of a few miles, and in addition, the covering fleet would require to be fully the equal, and probably greatly the superior in strength to the opposing navy. In an expedition of sufficient magnitude to approximate success, extending over the Atlantic Ocean, the transport would need to be so numerous that its clumsiness and vulnerability can well be imagined.

It has been somewhere stated that the estimate in 1878 for the Russian transport displacement in the Black Sea, called for five tons for an officer, one ton for a soldier, four tons for a horse, and eight tons for a vehicle.

Broadly speaking, a natural line of defense is one that furnishes, in its geographic and physical features, obstacles that in themselves facilitate defense, be it in preventing the forward movement of an enemy, or in enabling a smaller number of defenders to meet him on equal or favorable terms. The defense in a mountainous district bends its efforts to the passes, but in its rear should be a concentrated force ready to attack such columns as succeed in penetrating before time is given to deploy. Ships alone when successful over coast fortifications are not liable to such an attack, except in the common case offered by a river or by a harbor having a long narrow entrance,—in which case the passive defenses should be as efficient after the passage is forced, as at first. At the passage of the Mississippi, between forts St. Philip and Jackson, if the line of defense had not been limited to the line between the forts, but had also provided for a strong resistance in rear, with sufficient batteries posted in favorable positions on either bank, the defense would have been more rational. At Charleston, a defense equally strong with that of the outer line was provided in rear. Sullivan's Island, which amounted to one large fortified position, though its main strength was improvised, was intact throughout the siege, and on the inner lines of the defense were posted some of the heaviest guns, which never came into action.

In the Mississippi, this second line of defense was desperately held by a few vessels, which inflicted as much, if not more damage than the forts; but the line was not sufficient, and the flotilla suffered, as always, the fate of the inferior in numbers,—but the temper and skill of the antagonists were equal.

The geographic land frontier, if not forming a natural line of defense, that is, if not characterized by mountains, lakes, rivers, or deserts, will be abandoned as a line of defense, and one will be taken up more in the rear, or perhaps in advance. The sea frontier, a geographic frontier as well, must be held against ships, but the line of defense against invasion may be withdrawn, if it is not maintained at the landing point. The parts of a sea frontier that facilitate landing, possess more the character of plains; and battles between armies at such points may profoundly influence the pending conflict, and perhaps give rise to decisive results. The first battles fought by the invaders, as at Vimeira in Portugal, the Alma in the Crimea,

or recently that of Concon in Chile, were cases in point of vital importance. Certainly in the last two, had the results turned the other way, they would have been decisive conflicts; and Wellington at Vimeira was fully prepared for a repulse that would have compelled him to re-embark.

If the land frontier of a country is characterized by a desert, the natural defense is very perfect indeed. The obstacles to be passed are far more prohibitive than those offered either by a chain of mountains or by the sea. The position of the Chilean Revolutionists in the Northern Provinces, in 1891, separated by a desert from their enemies, has been termed insular, but the word is not strong enough; their position was such that they could be assailed only upon one side, upon the single sea frontier.

On a seacoast, while the harbors may, in a sense, be likened to the outlets of mountain passes, the passes themselves are unknown. When an attacking or invading force has left its base unnoticed, its course is known only to itself, until it appears in front of its objective; and then from its mobility, it can choose another,—the defenders still being in ignorance of the point of attack. These considerations and the use of steam, greatly favor the attack; but the greater number of men required for an invasion at the present day, the extent of the equipment, the telegraph and railroad, together with the torpedo boat and lookout vessel, have still farther favored the defense. Concentration by rail in superior force over the greater part of this country should well be accomplished during the disembarkation of the enemy.

Periodically, a scheme comes to the front, usually backed by influential opinion, which is to revolutionize all existing ideas of national defense. The torpedo was to have done that,—and while it may yet do so, the conservative well-balanced opinion only looks upon the torpedo as one element, though a most valuable one, of defense. General Paixhans, with his guns and shells, thought that there would be no more costly line-of-battle ships; only smaller inexpensive vessels not larger than frigates, carrying his ordnance. Sir Wm. Congreve fully believed that his rockets would replace artillery,—and so with the ram. Balloons dropping tons of high explosives may render useless other costly schemes, and in the Franco-Prussian war an ingen-

ious inventor planned to crush the Emperor, Bismarck, and Von Moltke by dropping three or four tons of iron down on them.

The subject of coast defense, or harbor defense more strictly speaking, has received frequent and fortuitous treatment at the hands of army engineers, who possess the great merit in their discussions and conclusions of agreeing closely among themselves upon the point at issue. There is little or nothing to be said in opposition to their conception of the strategic or tactical problems involved, or to their clear understanding of the means to be used. The amounts requested for the purposes of fortifications are not excessive, when the enormous extent of coast and the numerous inlets are taken into consideration; and the whole system of national defense, military and naval, goes forward as a well-studied and harmonious whole. The subject has, however, been more frequently presented from the military point of view. While not intending, nor attempting any criticism whatever,—there being no reason for any,—the matter may be viewed from a standpoint having a little different perspective. As might be expected, in England and France, where great fleets are maintained, the question of coast defense is a lively issue, and receives in every way the fullest and freest discussion. In other countries of the Continent of Europe, the course of coast defense marches on in its allotted place, in a perfected scheme of national defense, admitting only of modifications, as changes and improvements in material make themselves felt through the test of experiment or actual experience.

In England the coast is remarkably well defended, though the question of coast defense, generally, is the subject of a great amount of discussion. The division of control of its different parts is the same as with us: the permanent defenses and the submarine system being in the hands of the Engineers and Artillery. The mobile defense consists of the older ironclads, and vessels that have been laid on the shelf, together with gunboats and torpedo boat flotillas and their accessories in the way of depot ships, and countermining arrangements.

The development of the German Empire as a modern naval power furnishes an example that is perhaps unique on account of the short space of time which that development has required, and in the harmonious progress of all the means of offense and

defense. One idea has been taken as a basis and has been clung to throughout and developed consistently. The navy has not been built and then its base provided for, nor has the coast been fortified at the expense of the mobile forces. The security of the coast line has been taken as the starting point, and naval development has been projected outward from that starting point, while military development on the coast equally projected inward. There has been no hesitation, no going backward, no lapse in the scheme. While some other nations have offered the spectacle of not knowing or appearing to know in what way they should best proceed, with their policies undergoing annual changes so that in the end, instead of being strong in all directions, the military situation exhibits undue development in some directions and an equal contraction in others,—Germany has shown an equal and coordinate growth throughout. Her geographic situation and her form of government are to be credited of course with this satisfactory condition of things, and unlike England for example, her naval strength has not been absolutely essential hitherto to her existence, but has grown gradually as the necessity has arisen. Little is heard from German sources of disputes as to the relative importance of fixed defenses, garrisons, and naval forces,—the importance of each being recognized and each receiving its own share of government support. Coincident with the grand annual manœuvres, the coast defenses are placed on a war footing, when every detail provided for the emergency of war is carefully tested, i. e., the military roads and telegraphs, semaphore stations, search lights, submarine mines, signaling, supplies of ammunition, and gun exercise.

The safety of the remarkable coast line of Italy is provided for by heavy fortifications at the important strategic points and by the large ironclads which she has built. One definition or cause for their existence, as given by an Italian Admiral, is that, owing to the broken nature of the coast and the consequent difficulty of adequately providing it with fortifications, these vessels were to fulfill the functions of movable forts, the depth of water favoring their use in that manner. Taranto, at the southern end of the peninsula, is being made into a fortified point of the first rank, and it is a most valuable one, controlling the communications by water from either side, and forming a point of support between Spezzia and Venice.

Up to 1877 or 1878, the fundamental idea underlying the construction of the great Italian ironclads was that they were to be used in local coast defenses, floating fortresses as it were. The peculiar nature of the coast, its accessibility to attacks from the sea,—as landings can be effected at nearly all points,—and the railroads also lying along the shore, render it extremely difficult to provide for a national defense by means of fortifications. Since that date, however, the idea has changed, and the Italians now recognize that their best defense is in a fleet acting with points of support secured to it by fixed defenses. The change to this idea, and its development, is reflected in the course of her naval construction, and the formidable nature of the fortifications at a few well chosen places.

In general, the power contemplating the contingency that may deprive it of its naval defense turns in advance to the fortifications of its sea frontiers as its main stay for protection against the stroke for which that deprivation will have laid it open,—on the other hand, the power contemplating the desirability of such command of the sea as to enable it in the end to throttle the naval power opposed to it, unduly deprecates, in theory, mere permanent coast defenses, forgetful as well that in the course of such operations on the sea the enemy has frequently found its opportunities for retaliation, however hampered he may be by the disputed command of the sea.

A proper reading of principles would establish more just relations between the parts which go to make up the coast defense of a nation; and we should not see people clamoring for absolute invulnerability to be conferred by permanent defenses alone, nor others again, demanding the entrusting of the integrity of the nation to the single hand of the navy. Further, there would be less of the illogical demands that are frequently heard in this country, as well as in others, for the localizing of naval vessels; or of the prevalent belief that a navy is intended to take part in the defense of the coast as a present actual factor of harbor defenses.

In England, the discussions between the extreme thinkers, both naval and military, have taken on a somewhat warm character, which happily has given to the opposing views the clearest exposition; although in the heat of the argument the theories have sometimes been pushed to rather extreme limits

on both sides. Coast defense from the naval point of view in England finds itself primarily best insured in the augmentation of the sea-keeping navy. The method of defending the coast by the navy, and its true function and position in coast defense in the broadest sense, have been so ably laid down by Captain Mahan that his words are quoted, as they tersely and graphically exhibit that position and at the same time expose the weakness in the extreme naval argument. The principles are familiar by this time, but they acquire a new interest in their practical connection with coast defenses, meaning, in this case, everything which goes to protect a coast save the fleet, including all defenses, permanent or mobile. In discussing the naval policy of Great Britian in the earliest years of the century and in the closing years of the last century, Captain Mahan says: "But the widely scattered dominions of Great Britain offered many points besides the British Islands themselves to the blow of an enemy, and the navy had to protect not merely the heart, but the extremities, each and all of which were threatened in proportion to their value and their means of resistance when a hostile squadron was loose upon the sea. How then should this service be performed? By dividing the fleet among the points threatened, and establishing the line of defense close before the region to be defended? Not so should the true maxim, that the British navy was the first line of defense, have been interpreted. As in all military campaigns, the front of operations of a powerful fleet should be pushed as far towards the enemy as is consistent with the mutual support of the various detachments, and with secure communication with their base. By so doing, not only are the great national interests placed more remote from the alarms of war, but the use of the region behind the front of operations, in this case the sea, is secured to the power that can afford to maintain its fighting line close to the enemy's position."

"Not merely to check great combinations threatening great disasters, but to protect as far as possible minor but important interests, and for the security of commerce itself, the true station for the British fleets superior in temper, if not in numbers to the enemy, was before the hostile ports, and as close to them as might be. Then, though their function was defensive . . . they were ever ready, did opportunity offer, to

assume the offensive." And again he says: "A nicely coordinated system of defense does not contemplate that every point is to hold out indefinitely, but only for such time as may be necessary to receive the support which the other points of the whole are intended to supply. That the navy is the first line of defense, both in order and importance, by no means implies that there is, or should be, no other."

The naval extremists in England, while pushing their belief in the inadequacy of fortifications to fulfill any useful rôle in coast defense, provided their fleet is maintained at the strength they are ready to specify for it, on the other hand insist that any lessened naval strength can gain nothing from fortifications; for, as one of them puts it, the first gun fired in England, in anger, upon the coast is the signal for the downfall of the Empire. They support their position brilliantly and stoutly, they point to history to sustain and corroborate their views, and with such ability that, with the natural predilections of naval officers, it is easy to go with them in their argument, so far at least as England is concerned. While their words would seem to convey the meaning that they are opposed to all fortifications for the defense of the coast, or of the interior, they appear to be carried that far simply through a certain logical tendency of their arguments. If looked at as a question of cost, or precedence in the matter of expenditure, it would be impossible, if not criminal, to say that any object for national defense should be for a moment considered by English statesmen, while the fleet fell short of the standard that conditions absolutely impose upon it, and which, in threatening periods of the history of England have repeatedly been imposed upon it.

Sir John Colomb has wittily expressed a portion of this policy by calling attention to the fact that a cat does not go looking all over the house for a mouse, nor stay by the stove, but sits down in front of the hole and stays there till the mouse comes out.

If, as claimed by these radicals, their navy should be maintained in such a state of superiority that it alone can at all times prevent invasion or insult to the coast, in the complete application of the principle of fighting out the struggle on the enemy's coast; and further, if it be true as claimed that, with the loss of such naval superiority, or the ability to protect the coast by

naval means, England can be starved into submission without the firing of a hostile gun on the coast,—it then can be assumed that the expenditure of one pound on coast defenses for those Islands, until the fleet is in such a state of superiority, would be a gross waste of revenues.

England has, however, been subject to invasions and attempts at invasion, and it is interesting to note in connection with the attempted invasion under Thurot in 1760, which landed at Carrickfergus, that England was then in possession perhaps of the most absolute command of the sea has ever held. When, as Professor Laughton says: "Hawke and Boscawen had completely crushed the French navy; when our ships cruised unmolested in the Bay of Biscay, or lay peacefully at anchor in the French roadsteads; but for dissensions amongst the French, Belfast would have been sacked."

In the years from 1804 to 1810, while the number of vessels in commission in the Channel and in the North Sea amounted to nearly three hundred, the coasts of England were repeatedly liable and subject to insult. Large numbers of gunboats for harbor defense were also in use by the English, but it was impossible to cover every point, and secure every such point from predatory attacks.

Another set of considerations of recent development, emphasizes the need of permanent coast defenses. The annual naval manœuvres carried on in England and Russia especially, have shown most conclusively that even under peace conditions, the complete blockade of steam vessels is very difficult, if not impossible. Vessels have escaped in the English manœuvres, and have proceeded to raid the enemy's coast, sometimes even in violation of the plainest strategic principles. The blockaders have been compelled to concentrate for home defense. In Russia, the blockaded fleet has escaped the blockading fleet both outward and inward. The conclusion is certain that the conception of the proportion of the numbers of the blockading fleet to those of the blockaded to ensure coast defense, must be largely increased, which opens the possibility, also, that less places can be blockaded. In the Civil War, the ingress and egress of blockade runners was not stopped until the last stronghold of the Confederacy was in the actual possession of the fleet.

In the French naval manœuvres of recent years, it seems to have been an accepted assumption that the possibilities are all in favor of attacks on the coast line. The dispositions for the attack and defense have received the greatest attention. Those responsible for the filling of the two rôles, have been given full powers, and the question—the assumption once made—has received the most careful tactical treatment. The desire is, evidently, to develop the condition as regards efficiency of the coast defenses of all descriptions.

The French manœuvres of 1892 established as far as possible the efficiency of torpedo boats in coast defense. Their success in night attacks upon the attacking squadron was very marked. The superiority of the coast defenses over the fleet was also very generally allowed; but in the Mediterranean, combined operations in the hands of the attacking force were generally successful. A place so open as Cherbourg, where the difficulties in the way of providing suitable coast defenses are extremely great, is considered very efficiently armed against a formal assault by sea. The weakness lies in the rear, where a landing force may be able to possess itself of the heights overlooking the city.*

Serious questions may be raised as to opinions openly expressed in England, that when the command of the sea should have been wrested from the English and when the remnants of her fleets were shut up under fortifications, that it would be the poorest policy for the enemy to attempt direct operations on the coast of whatever nature, such as the bombardment of cities and arsenals, invasion with London as the objective, or a contest with fortifications. It is held that the enemy, by placing himself across the trade routes converging towards the kingdom and shutting the British Islands off from all communications with

* The value of the annual manœuvres is very great in illustrating the need of coast defenses of a certain strength and character for even superior naval powers. In many respects the manœuvres reproduce actual warfare. If vessels escape a blockading force by evasion and without being seen en route, appear before a hostile port or on the enemy's coast and effect a junction with another detachment, they have done exactly what would be done in war, no more and no less. The similitude is real. The question of chance or the point wherein the scheme of the manœuvres is weak, is similar to results which follow the tactical questions when vessels or squadrons come within sight of one another.

the outside world, could soon reduce the invested people to such an extremity that peace would be demanded. The fact that for every four pounds of food stuffs consumed in England for the sustenance of life, not much over one pound is produced in England, gives color and strength to this view. At the same time, it is reasonable to think there is danger of too much being imagined,—it being one thing to assume the possibility of such a complete blockade as is indispensable to reduce England to such a strait, and another thing to carry it out. The customary trade routes may readily be watched; the whole system of supplies may be disjointed; but under such stress other routes will be found. The whole circumference of the Islands must be patrolled, and experience goes to show that patrol and watching are not sufficient. This patrol must be kept up, it should be remembered, under conditions in comparison with which other blockades were child's play. The winter blockade of our Southern ports was terribly hard and difficult, but easy when compared with the winter blockade in the North Sea or in the Channel.

There are cruisers with a maximum speed on paper equal or perhaps a little superior to that of the Atlantic liners, their number in comparison, however, being extremely limited; but their speed is only good for a short time. The cargoes which a small number of the biggest and speediest of the liners could carry into the kingdom—and they will not be constrained like sailing vessels to follow particular routes—would tend effectually to prolong the resisting powers of the nation. It cannot be admitted that a vessel which can average 19 or 20 knots, or even 23 knots and more as they now do, across the Atlantic can be intercepted by cruisers which can make 22 or 23 knots for a limited time under favorable circumstances, while subject to the greatest tension. Of course all the trade under sail or in tramp steamers would disappear. In a vital struggle however, as long as Englishmen can be supplied, it is not safe to look to their giving in under hardships falling short of the unsupportable. An English writer has pointed out that in such circumstances the productive power of the Islands themselves would be doubled or trebled.*

* Not long since the opinion was expressed by Admiral Long, R. N., that there is no power on earth that could prevent food stuffs and raw material entering the country.

At such a stage of the war, the manufacturing interests would be employed to their utmost; workmen would suffer, but shipbuilding would go on in all its forms. Fleets would be repaired and provisioned, torpedo boats built, concentration effected, but all under fortifications, without which the downfall of the Empire would indeed be coincident with the loss of the command of the sea. Fleets or their remnants would begin to make their appearance from India, from the Pacific, from every direction. Communications would be managed in some manner if entrance could not be secured, and the ordinary strategic combinations would be arranged.

With the exception of the naval school to which reference has been made, thinking Englishmen are satisfied that the approximate sealing up of the enemy's fleets to the extent of preserving the coast line from all insult, while desirable, is a dangerous myth. The enemy's fleets must be met in battle, and the English, as well as the enemy, must endeavor to be superior at the point of contact; while providing otherwise and contingently for the actual safety of the coast,—but it is unnecessary to form such opinions concerning England's policy, for it will hinge assuredly in the end upon her so far unrivalled sea power.

To a power such as the United States, up to now contemplating naval inferiority, and having in view a small navy comprising many types, the words above quoted of Captain Mahan are full of meaning,—and it is only the possession of a greatly superior naval force that can in any degree justify the neglect properly to fortify the coast, and to maintain the organization necessary for national defense. Of all the sea powers England

In former days the English have blockaded, or masked, all the military ports of France and Spain combined, at the same time maintaining squadrons in other waters. It is difficult to believe that it will ever be possible for them to do so in the future, and this is practically admitted.

The French fleet was able twice to elude Nelson off Toulon, but in those days some judgment could be formed as to the direction taken by the escaping fleet by the direction of the wind, and it could be pursued with better chances of being on the right track than now. It was Collingwood's opinion, that the fleet in Toulon could always escape when it wanted to. The observer on the hill could watch the masking fleet, and give the proper directions to the inside fleet, enabling it to elude the watchers. This may perhaps be taken as an indication of a sphere of usefulness for balloons in coast defense.

alone,—and then only while supreme at sea,—can in any way treat the question of harbor defense lightly,—but if she should do so, with her wealth, she would be taking unnecessary risks. But as before stated, England has placed her coast line in a remarkably efficient state of defense, some of the engineers going to the extent of criticizing the magnitude of the works, claiming unnecessary strength at some points.

The frequent and favorite conception of the rôle of fortifications in coast defense, viz., to set the navy free to take the offensive on the enemy's coast line, while the home coast will be protected by fortifications, appears to be somewhat faulty.

It is not clearly apparent that the actions of a navy in war would be greatly affected by the presence or absence of permanent defenses, provided that the general balance as between the superior and inferior force was not disturbed nor altered. The navy in defending a coast has its own peculiar ways in doing so. It is true that the total absence of fortifications would place a great weight of responsibility upon a naval commander, but, it may be asked, how would the presence of fortifications affect the diverse strategies of a superior and an inferior fleet. Would their presence, for instance, permit the inferior fleet to cross the ocean to assume the offensive on our enemy's coast, while that enemy's fleet was either in observation of the inferior or contemplating enterprises on his coasts?

The relations are much closer than those suggested, and the action of the navy should be no less defensive in its results than that of the permanent defenses. So far as it lies in the power of the navy, a great part of its whole duty is to relieve the strain on the coast line in whatever manner that can best be accomplished.*

If, by threatening one or more important strategic points the enemy is drawn away, the navy has fulfilled its mission in that respect. Serious operations of any nature of an inferior navy against an enemy's coast are accompanied with the greatest risks, and in these days of steam and ready communication,

* Throughout all the wars of the 18th and 19th centuries in which England has been engaged, it has been insisted by admirals and statesmen that the attitude of the English navy has been entirely defensive, and yet the scene of the action has been largely away from the British coast.

they are still more hazardous than formerly. Such an operation in the old days could take place and be effective before the intelligence that it was contemplated could be received, and the length of time required to act upon the intelligence was vastly greater. To-day the lookout and the cable would give the news instantly. Calculations regarding time have to be made with the greatest nicety, and any operation requiring a length of time for its accomplishment, with the attendant contingencies, should be considered extremely rash, though perhaps justified.

The permanent defenses, besides exercising this deterrent effect, further gain time in which relief may come, be it to repel an invasion, or to raise the maritime siege. This growing importance of the element of time with other considerations brought about by steam and quick communication may have produced a modification in some of the strategic combinations in a maritime war, but what they may be, until subjected to test, no one can say with authority. Blockade is forbidden to the inferior navy, and there can hardly be two opinions now-a-days as to the non-efficacy of commerce destroying as a main object in maritime war.

The inferior fleet engaging a detachment of an enemy's fleet is as surely taking part in the defense of the coast as can the permanent defenses. If unsuccessful, the victor may be so disorganized as to force him to abandon any attempt, and thus time is gained to the defense.

At the battle of Yalu the superior force, the Japanese fleet, was so disorganized by victory that the advantage was not pushed home. The Chinese vessels not captured or destroyed were thus able to make Port Arthur in safety where their presence contributed to prolong the defense.

Coast-line battleships, a term accorded to some of our battleships, while it is perhaps a little offensive to those who object to the restriction of vessels to coasts and harbors, is none the less, an accurate definition of every battleship in the world.

There is one position in which ships are of no use in coast defense or anything else, and that is where a number of them are shut up in a port under no matter how many guns, if no outside relief is looked for. Such a fate might easily befall the vessels of an inferior fleet seeking repairs or stores in the best protected arsenal, where there is little or no possibility of the blockade

being raised from the sea. Cervera's predicament in Santiago may be recalled. It may appear that the positive assurances we sometimes hear as to the rôle of fortifications on the seacoast need some little modifications. They can without doubt put certain places or positions beyond the power of actual physical injury from the side of the sea, but they can hardly set vessels free from the same duty. At a point such as Key West, for instance, they are absolutely dependent upon a navy for their existence, in other words, for their defense. They have done their work when in addition to protecting an important base for the navy they have gained time, and their whole rôle is bound up with that of a navy.

It is possible that in the minds of some people other misconceptions have arisen as regards the functions of a navy in a maritime war. Can it be supposed, for instance, that our navy could carry the operations of war to an enemy's coast while our own shores were threatened? That each navy, our own and the enemy's, would be free to act offensively against the coast of the other? Such a state of affairs cannot be imagined. Navies cannot be set free in any such sense by fixed defenses. The first objective of any navy is the enemy's fleet,—to fight it if able; to keep touch with it always, and to endeavor to create the opportunity to attack it on favorable terms whether it be on its own or on the hostile coast, and it is almost beyond question that the main operations will be in the waters of the inferior power.

In an official communication made to the Chief of Engineers in 1881 by Lieutenant-Colonel Q. A. Gillmore on the general subject of seacoast defenses, after recapitulating the weakness of our seacoast fortifications, in view of recent strides in the production of destructive engines of war, born of modern invention and science, the question is reviewed as to the entrusting of the defenses of the nation to one of the elements of defense singly. He discusses the question most ably, and conclusively establishes that such a policy would be ruinous. Concerning naval defense, he says:—"The idea that a navy, especially an 'ironclad navy,' can furnish a sure defense, although both attractive and popular, finds no practical application among naval powers. Its soundness as a theory is freely admitted

because a harbor fleet, if as powerful as the enemy's, would be expected to make and no doubt would make, a good defense. Every one at all familiar with the achievements of our navy will cheerfully concede that point. But, at the very best, in that case our chances of victory would be only equal to those of the enemy, while the risk taken and the consequences to ensue from failure would be greatly unequal; for while the enemy could lose nothing but his fleet, we would lose not only our fleet, but those much more valuable possessions which the fleet was designed to protect. Where interests of great magnitude are at stake, ordinary prudence requires that as little as possible should be left to the caprices of chance. A safe and perfect defense of this kind implies, therefore, a harbor fleet somewhat more powerful than that of the enemy.

"It implies, also, that each point deemed worthy of protection, large and small alike, shall have a fleet as powerful as that required for the most important localities. Otherwise, lacking strength at all points except a few, our smaller navies, and the objects to whose defense they had been assigned, would be destroyed in detail. And finally, after having accomplished this work at his own time and pleasure, the enemy might, when confronted by an equal or superior force at our strongest positions, decline battle altogether, withdraw from our coast, and direct his efforts against our commerce upon the high seas, a commerce left entirely at his mercy by the policy which keeps the navy in port for home defense. The enemy having left his own ports well defended by fortifications, a condition substantially true of all great maritime powers except the United States, would be free to adopt this course.

"If it be contended that a proper naval defense can be made by seeking the enemy upon the ocean, or by shutting him up in his own ports, thus leaving our coast entirely defenseless—without either forts or vessels of war—the answer is that such an assumption is not only at variance with all the lessons of history, but is in itself intrinsically illogical and weak. The power to escape from or to evade an enemy upon the high seas or break through a blockade, never very difficult of achievement, especially at night, even in the old-time sailing vessels, has been rendered comparatively easy and certain by the introduction of steam.

"Moreover, under this method of defense, the weight of advantages would be with the enemy, and the weight of risks with us. Being equipped and embarked for a naval attack on our coast he could scarcely wish to encounter our fleet, constituting the only defense of that coast, under circumstances of brighter promise to himself than those offering upon the broad ocean, for he could then either engage us in battles, or withdraw, under cover of night; and should he elect to withdraw, which would be the prudent course if inferior to us in strength, he could, at his option or as might suit his purpose best, either retire under his own fortified ports, or pursue and destroy our commerce on the high seas, or make a sudden descent upon our unprotected coast. Should he adopt the last named course, he could even venture for this purpose to subdivide his fleet into small detachments, being certain of success at all points, because certain of finding our harbors unprotected by fortifications, and our fleets absent upon the broad sea. It would seem therefore that a cruising force, even if much more powerful than the enemy's, cannot be wisely relied upon for the defense of an extended seaboard.

"These views are neither new nor novel. They are, moreover, believed to represent the matured judgment of the highest military and naval authorities, as they unquestionably do the practice of the great maritime powers of Europe, as embodied in their methods of seacoast defense. If they be substantially correct, as stated, a secure defense by naval means, although entirely practicable, requires not only that the navy shall be permanently retained upon our coast, and within our harbors, but that its power at each point deemed worthy of protection shall somewhat exceed that of the single fleet which the enemy can bring against us. Not knowing where the enemy intends to strike, it would be necessary to be prepared for him at all points. If twelve armored vessels, properly equipped with torpedoes, be assumed as the limit of the offensive power, we must maintain more than a score of fleets, each more powerful than the enemy's twelve vessels, in order even to defend a few of our most valuable localities, and prevent their destruction and capture. And even upon this broad and costly basis, nearly one half of our harbors for armored vessels and more than one half of our Atlantic and Gulf coasts would be left entirely defenseless."

This extract is given in full for a twofold purpose and because it is the opinion of one of the highest authorities. In the first part of the extract, the author deals with the question of naval defense, apparently limiting the sphere of action to defensive vessels located within harbors without power of concentration, in other words, to coast defense vessels in the most restricted sense. His arguments have been used a great many years and with good effect. They should absolutely and forever put to an end any idea that a navy, however powerful, divided up among the harbors of a country, unless always and everywhere presenting a front of greater strength than any possible force to be brought against it, can be considered as anything but a navy destroyed. Unless, indeed, the detachments are composed of seagoing fighting vessels, to which the opportunity for concentration may occur before the detachments of the enemy's fleet can combine in superior force,—such as the opportunities offered occasionally to the Spanish and French in the great naval wars of the last century and the beginning of this,—but how would it be with vessels fit only to fight in smooth water? President Jefferson upheld a scheme of the kind for a while, but it was ultimately put aside, and Major-General E. P. Gaines in 1839 strongly urged such a scheme upon the attention of Congress, happily without success.

It may be that there are people to-day who pin their faith upon thus continuing the naval policy of the country, but a contemplation of the question from the point of view as stated, should be sufficient to satisfy them of their error. No possible issue can be taken with General Gillmore upon the question as to the need for permanent defenses and the danger to the coast without them, but in balancing the risks and benefits to the attacking and defending force he says that a victory for the defense would cause only a loss to the attack of its fleet, and he does not refer to the incidental preservation of the coast line insured by that destruction of which history is so full of examples, even when there has been no destruction to speak of. In the remainder of the extract the author deals with the question on the assumption that the vessels may even form a cruising force, and it is submitted that what has been said as to misconceptions on the part of some people concerning the functions of a naval force in naval defense needs no further demonstration. A fleet is

equipped abroad for a naval attack upon our coast, and of course we are presumably in perfect ignorance of this. It is admitted that he may be inferior in strength. Our fleets are absent upon the broad sea somewhere, certainly not watching the enemy's fleet; the enemy being superior or inferior in power but equipped for a coast attack seeks the accomplishment of his object through evasion, which should be very difficult if thorough alertness and preparedness are displayed by the Admirals of our fleets and the intelligence staffs. He even divides his superior or inferior force into small detachments and falls upon our coast line at all points, or, as it might be put, he divides his forces in the presence or the existence upon the sea of a superior force. No exception can be taken to the statement as regards the practice of the great maritime powers of Europe, as embodied in their methods of seacoast defense. The practice so far as is known lies in a proper coordination of all the elements of defense, together with a frank recognition of the preeminent and preponderating place of the naval defense. The hypothetical demonstration of the requirements necessary in order to ensure a perfect naval defense in the last paragraph does not concern those who concede the indispensable nature of permanent defenses.

But the numbers used go far towards the conviction that twelve ironclads of the enemy would be lost under a better conception of what is meant by naval defense. It seems it would require more than 240 similar vessels opposed to the twelve, under the system of defense which he declares to be entirely practicable, and then, " more than one-half our entire Atlantic and Gulf Coasts would be left entirely defenseless."

After disposing of the general subject-matter as regards seacoast defenses in the ablest manner, the author answers the questions as to what are the exclusive and appropriate duties of the navy, as derived from high naval authority—" as aggressive war is the special mission of that arm (the Navy) . . . the country would expect it to protect our commerce on the high seas and convoy it safely into port, enforce respect for our flag in foreign ports, capture the enemy's merchantmen, and destroy or confiscate his goods contraband of war; search out and engage his armed fleets; blockade his ports; and generally, as Admiral Dupont once said ' carry the sword of state upon the broad

ocean' and 'contend for the mastery of the seas where alone it could be obtained, on the sea itself.'" Not one word here about attacking the enemy's seacoast fortifications. We are to spend millions as against his coast attack and no provision for us to get any return for it. One policy for us, another for the enemy as he is always to be freed by his fortifications behind him. It will be noticed that the seeking out and engaging the four armed fleets and of blockade are placed last in the list of naval duties, and it is not made clear where the attack on our coast is to come from if the enemy's armed fleets are sought out and engaged unless our fleets are destroyed, and then what can fortifications do?

It is but proper to say that the letter closes stating that it is not "specially addressed to the technical expert in military or naval affairs," the wish being "to reach that larger class of intelligent thinkers who mold the ideas and dictate the laws of the nation." History, his own experiences, and our reasons, agree with all that General Gillmore has to say concerning the efficacy of a navy tied in detachments. He has as large an opportunity during the war as any individual to see the total inefficacy of such a system and into the use of which the Confederates were driven, but there were many who failed to see how the Union fleets were protecting the northern coast winter and summer while before the southern ports, and to which fleets the sea coast fortifications of the north were not, as it happened, of much use.

Where General Gillmore refers to the ease with which a blockade can be evaded in these days of steam, and the fact that the assumption of a close blockade is at variance with the teachings of history, he is of course undeniably correct, but it does not seem that he pursues his argument to a logical conclusion, or rather that his succeeding assumptions are only assumptions not based entirely upon history. The assertion is made that "being equipped and embarked for a territorial attack he, (the blockaded enemy,) could scarcely wish to encounter our fleet." It might be asked what was the object of all the grand fleet movements of the French and Spanish in the Napoleonic wars if not to neutralize the action of the English fleets? The command of the English Channel was deemed by Napoleon absolutely essential as a preliminary to any territorial attempt upon

the shores of Great Britain. The superiority of his fleet was the object of his manœuvres. The detachments of the allied fleets were not shut up in the ports, but they were tempted in every way to come out, and when they got out their only object was to gain, by combinations, a superiority over the enemy. This they were unable to do simply because of the proper strategic use of the English fleets. They knew too well the absolute futility of merely avoiding these fleets.

The idea that such operations of hostile fleets, as each acting independently on the enemy's coast or preying upon his commerce, had any influence in bringing war to a close was definitely abandoned in the 16th century. The question is sometimes put thus; if the fleets are equal and succeed in inflicting equal damage, how then is the war advanced to its close any more than if no damage were inflicted? It is inevitable that the first struggle will be for the command of the sea, in case such command is not admitted in the beginning. Imagine ourselves at war, possessing a great naval superiority, and with our harbors unfortified; the harbor of the enemy being provided with efficient works,—can any one suppose that the inferior fleet would have any time or inclination for attacks upon our own coasts, which could have no appreciable effect on the ultimate result except in the exasperation of the people? On the other hand assume our coasts fortified, and our fleet the inferior. If any one has shown or if any experience has demonstrated how the fortifications, so long as our inferiority at all points exists, can free our fleet to attack the enemy's coasts so as to make any impression upon him, it is not generally known. The fate of a coast rests in the beginning and in the end, fortified or not fortified, *upon the command of the sea.* This does not mean that the coast should not be fortified, but seeks to determine what strain may be brought upon the line of fixed defenses and at what stages in a naval war.

If commerce can be protected, and the coasts secured from insult by naval actions,—it is then certain that the navy is the factor of first importance in defense, but the other factors cannot be disregarded. A very complete instance of the relations existing between fleets and fixed defenses is to be found in the events connected with Nelson's great victory of the Nile. The departure of the French fleet with Napoleon's expedition to

Egypt freed Nelson, and when that fleet anchored in the unprotected waters of Aboukir Bay it had accomplished nothing and had given Nelson the opportunity he desired. So it may be said that when the fortifications of Toulon freed the fleet from the duties of defending that harbor by an active offensive against Nelson, that they did a very bad thing for the fleet and for France.

It is easily apparent that the naval policy of England should be just what is laid down by Captain Mahan, and it is asking too much that the whole fabric of defense should rest upon that one line of vessels on the enemy's coast. If it should happen, for the sake of argument, that at last the fate of the British Empire hung in the balance to be decided by one grand fleet action on the enemy's coast or elsewhere, it is certain that were the English fleet successful, fortifications would play no part. If unsuccessful, they would be of no use. But before the Empire could be reduced to such a strait, fortifications would have played their useful part in covering and sheltering vessels of the fleets seeking repairs, in forming safe harbors for a belated commerce, in deterring light squadrons from raiding the coasts, securing, starting and returning points for the mobile defenses,—and above all in case of disaster to the fleet, sheltering it and gaining time for the certain relief to be expected from other fleets.

Previous to the battle of Waterloo, while Napoleon was projecting his march upon the allies in Belgium, he divided the army into corps, and assigned to Marshal Grouchy the command of the right, and to Ney that of the left, entrusting the defense of Paris to Marshal Davout, himself commanding in person the reserve. Davout pleaded with him for the command of the right in place of Grouchy, who had never commanded more than a division, urging that in face of a decisive campaign such as the one projected, that interior defense was wholly secondary. He said, " If you are victorious, Paris will be yours; if you are beaten, neither I nor any one else can help you." Whatever the fact as to the mooted question that Napoleon's refusal to comply with his urgings may have contributed to the loss of the battle of Waterloo, these words express completely the limits placed upon fortifications in such contingency. Had there been in the field another army, or had it been possible to

create another army in France, with Paris as the rallying point, the fortifications of Paris would have been of immense importance. The fortifications of Plevna would have played just such a part had there been another Turkish army in the field. In another war, in 1870, the defenses of Paris fulfilled to the utmost the province of fortifications, but as the military resources of France were exhausted, it may be questioned if she might not have fared better if there had been no fortifications. On the sea frontier, her coast defenses from the nature of things were of no use whatever to her, except that they prevented depredations which do not seem to have been very seriously contemplated by the weak German navy. But the seacoast fortifications of Germany were of great utility to her in conjunction with the small German squadron stationed in the Jahde.

The naval events of the Franco-Prussian war are again referred to, for while very little was accomplished on either side they are extremely interesting and throw very strong side lights upon the mutual relations of the elements of coast defenses. Indeed some authorities go so far as to deduce from them a corollary to the laws of naval strategy, to the effect that a superior naval force will not proceed to territorial attack while an inferior force is in existence free to act, though at a distance so great as 800 or 900 miles. We can assume this to be almost absolutely true, and the incidents of this war upon which it is founded or its truth corroborated, are worthy of notice, but it is not thought they bear out the assumption so fully as do many historical events. While great strides have been made in the development and refinement of weapons and in the organization of the *personnel* of fleets and coast works since the date of this war, yet, the strides that had been made up to that time were great, and the resemblances between the fleets of that day and those of to-day are so close that we may rationally expect to see a repetition of many of the circumstances surrounding the actions of the French fleets, and certainly there is a great deal to be learned from the defects and limitations which were brought to light.

At the outbreak of the war, it was designed that Germany should be assailed in front on the road to Berlin, and at the same time that a combined army of French and Danes, supported by an ironclad fleet, should threaten the country by the northern

flank. At that time, the French navy was to the German navy as three to one,—and there was ample ground for the belief that the Danes would furnish a quota of 40,000 troops, which with the 30,000 to be sent from France by sea under General Bourbaki, and the covering fleet, would certainly immobilize at least 200,000 Germans for the defense of their flank. As a matter of fact, the mere threat of such a formidable attack was sufficient to cause the German leaders to post an army corps of five divisions, in addition to all the troops belonging to the four divisions of the coast, on the neck of the Jutland peninsula whence it could succor the shores of the Baltic or the North Sea as occasion demanded,—and for a long time the main army of the Germans was deprived of this great number of men. Count Bouet-Willaumez was selected to command the mobile squadron to be sent on ahead, and upon him in the end largely fell the blame for the lack of results which seem to have been mostly due to the want of understanding in Paris of what a fleet could and could not do. In the first place he was started off with a fleet consisting of seven ironclads and one corvette insufficiently coaled and supplied, instead of at the head of a fleet promised him of fourteen ironclads, corvettes for lookout work, and especial vessels, so necessary for territorial attempts, and complete in every respect. There was also a lack of desirable charts in his fleet. This was to be followed by a second fleet, so constituted as to make up all deficiencies and to convoy the army corps of Bourbaki. It also happened that his fleet could not be efficiently manned because the outbreak of the war found the men of the inscription maritime, who should have been immediately available, away at the fisheries.

The instructions to Bouet-Willaumez were to cruise off the Jahde and to bring the German vessels there to action; he was forbidden to attack open coast towns. He found himself unable to force the Germans to fight, and put into a Danish port for coal.

The French minister ordered him to the Baltic, then despatches came for him to detach a force to observe the enemy in the Jahde and to establish a base somewhere to watch the German coasts and also to observe Danish neutrality, all of which was a large undertaking for a fleet three times the size.

Finally, a definite order was received to proceed to the Baltic, which he did with the aid of Danish pilots, and after establishing his base in Kioge Bay, a few miles south of Copenhagen, he proceeded to reconnoitre the German coast in order to familiarize himself with the condition of the defenses and the possibility of throwing the coming army on shore. He also desired, if it should be found feasible, to attack some of the fortified coast towns; though for the lack of special vessels, he had little heart for the work, and the harbors all appeared efficiently obstructed. Stakes, submarine mines, nets, and vessels ready to be sunk, lay at every entrance; and the nature of the coast where all lights were extinguished and buoys removed, made approach very hazardous for a heavy squadron. In this situation, the Admiral one day in August received three contradictory orders by telegraph; one ordering him to return to France, another countermanding the first, and a third to strain every nerve to do the enemy injury as the French army had suffered reverses. By this time the Admiral had selected a place which was to be utilized for the great landing and which was suitable for the base of operations which were to commence on the Schleswig coast.

The order also informed him of the departure from Cherbourg of the second squadron under Admiral Fournichon for the Jahde, but nothing was said about landing forces, and he was further told that his chief means of action lay in close blockade of the German commercial ports.

He again reconnoitred the coasts and returning to Kioge Bay summoned a council to submit a written report upon what was possible to be done with his squadron.

The report of the council is interesting in many ways, and especially in calling attention to the limitations placed upon a homogeneous battle fleet in the presence of coast defenses:—

"Alsen.—The depth of water will not permit an approach to this point within at most 3000 m., a distance at which engagement would be useless on account of the plunging fire of the forts. Nothing is here possible without a force to land. Besides it is most probable that submarine defenses extend along the shore, which it would be indispensable to remove, and which would not be attempted until the squadron was supplied with necessary materials.

"Duppel and Kappeln.—Completely out of reach from the

ships' guns. Too little water in the bays. We could only get at them with armored gunboats.

" Eckenfjord.—It is easy to destroy the isolated batteries, but they are of no importance, and without the possibility of throwing troops on shore the reduction of the forts would be insignificant.

" Kiel.—It would be necessary to employ the whole force of the squadron, the success of gun fire uncertain, on account of the height of forts above the shores, and the losses certain for the assailants if they were not able to occupy the forts as they were silenced. The forts at Fredericksdort being destroyed and the squadron unable to penetrate to the bottom of the bay within gunshot range of Kiel, on account of the obstructions, the torpedoes, and all the means which have there been accumulated, the French ships would be forced to retire without even knowing the result of their attack.

" Neustadt.—An open town and without defenses, but with a bay so shallow that the French ships could not even reach with their projectiles the merchant ships which are anchored some distance from the port, properly so called. It is the same all along the coast so far as Colberg, a strong place besieged in 1807 and attackable from the sea at 2200 metres. Before entering upon action there it will be necessary to make a reconnaissance in order to make certain, that the houses along the shore, the casino in particular, do not mask fortifications which would compel a modification of the form of attack.

" Danzig.—The fort at the entrance of the bay is within range of our upper deck guns but only at a distance of 4000 metres. The battery guns could not be used elsewhere with advantage.

" Conclusion.—Colberg and Danzig alone can be attacked; but the small effect which will result from these two attempts will be of a nature to deprive the French squadron of the prestige of its force. In order to operate usefully, special vessels are required and the prospect of forcing the enemy to assemble his troops on this part of the littoral, but this end is unattainable without a landing force."

This report is valuable as showing the condition which confronted the naval Commander-in-Chief, and what under such circumstances may be considered as the indispensable requisite for a fleet in order that it can enter upon a course of warfare

other than engagements in the open sea. Bouet-Willaumez had taken his squadron, through the only channel available, without charts and with but nineteen inches at times under his flagship, only to find himself in a condition to be able to do almost nothing. Blockade did not amount to much, for the Germans were keeping their vessels, which had not been turned into Swedes or Russians, in port, and small vessels continued with impunity to pass along the coast, while small gun- and torpedo-boats continually harassed the vessels of the French squadron. One light draft monitor showed what such vessels could do on certain coasts in the way of eluding hostile vessels and keeping out of reach of the only vessels that can harm them, but as the monitor accomplished nothing except to keep out of range, the lesson is not enforced. If Bouet-Willaumez had had a few torpedo cruisers he might have destroyed the monitor which was hardly, under the circumstances, a threat to him.

At the moment of receiving this report the French commander, who had determined to make a demonstration against Colberg, received news to the effect that the German fleet had left the Jahde and had been seen heading for the Baltic. He did not hesitate for a moment, but headed for the enemy. The information was wrong, however, for the German fleet was now closely blockaded by another detachment of the French fleet, and Bouet-Willaumez learning of this, declared a paper blockade. He divided his squadron to blockade two sections of the Baltic coast 300 miles in length, and left two vessels in the open sea. Gunboats made their appearance at all times, and proved very harassing, for there was but the one vessel to act against them. In replenishing at the base, each vessel required another as a guard, and the squadron was being exhausted while actually doing nothing. A few changes took place in his fleet, two of the heaviest vessels being replaced by lighter vessels, one being the Rochambeau, the old Dunderburg which du Pont Jest says France swept away from Germany for a consideration of some millions when she was put up for sale in New York. The French Admiral determined again to operate against Colberg with a detachment of his squadron. Arriving off the place, he saw the terrace of the Casino crowded with women and children and the Geneva cross flying on all the principal buildings of the town. After consultation, he determined not to

make the attack, and drew off. A few days later he received a despatch coming from the French ministry which the author before quoted claims was probably a ruse de guerre, ordering him to bombard the open towns of the Prussian coast. The Admiral disregarded the despatch, and was now engaged in fighting the September gales. At his base he heard of Sedan and received orders to continue the blockade and to injure the enemy. He again determined to bombard Colberg, for now the place was largely deserted. The bad weather, however, defeated his object and compelled his return to Kioge Bay, where he received word, this time accurate, that the blockade of the Jahde had been raised, and he then determined to proceed in that direction. He arrived off the Jahde and cruised a day, but the German vessels would not come out; he then returned to Cherbourg, and thenceforward two squadrons alternated in watching the North Sea coast of Germany,—and to make things doubly sure, some vessels cruised in front of the French ports to blockade any German vessels from getting in that might have escaped the watch on the German coast.

In view of the circumstances as just given, which are substantially accurate, it is not quite fair to say that the little German squadron in the Jahde prevented any attempts against the coast cities in the Baltic. It certainly had its influence, but so did the bad constitution of the French squadron, the character of navigation, the bad weather, and the formidable character of the coast, beside the dislike of Bouet-Willaumez to bombard towns which would have given the Germans such good grounds for reprisals in kind. All these events are significant enough without an effort to emphasize the influence of a naval flanking force which has always been in evidence. Besides, if he had been fully bent upon coast attacks, all he had to do was to make them while keeping a lookout to the northward and he certainly could have counted upon receiving accurate information quickly through the Danes of the proximity of the German fleet. But it is perfectly true that no serious attempt requiring a period of time in its execution, could have been successfully undertaken while there was the certainty, or even possibility, of interruption. On the western side of Denmark things were also going in a similar manner to those in the Baltic. Admiral Fournichon, in command there, could not establish any base, owing partly to the

nature of the coast and to the constitution of his squadron which was similar to that of Willaumez though he had four small vessels. All his replenishments had to be made in the open sea, yet for a time he managed a complete blockade of the Weser and of the Elbe, but quoting du Pont Jest once more " soon unfortunately, the weather became bad, gales succeeded gales, and the replenishment of the ironclads which could only be done by boats in the open sea, became very difficult. The heavy ships of the fleet continued to struggle vigorously against the elements, but the colliers and store ships not only failed to arrive with the same regularity, but they often remained knocking about at sea before being able to join the squadron, and the loss of a certain number of them was fatal. Moreover, the season was advancing, the equinoctial hurricanes were imminent, and the French ironclads would soon find themselves without coal in the most critical position."

Fournichon, nevertheless, maintained himself in position for sometime, but was about to give it up when he received news of the downfall of Napoleon and his own appointment as Minister of Marine. He then left the station with his squadron and hastened to Paris thus raising the blockade, upon which Bouet-Willaumez proceeded off the Jahde. In all these operations, the open coast towns owed their safety largely to sentiment. As fortified places, the influence of fortifications in preserving them is sufficiently apparent, as well as the influence of the German fleet. There seems no necessity to go to the extreme of claiming that the German fleet saved the coast.

In our Civil War the fortifications of the North did not come into play, while those of the South were of the last importance to the cause. They enabled her to hold out to an extent possible only on condition of their existence. The margin by which the fortifications of the North escaped the test of trial was very small indeed. Had the plans of the Confederates for the acquisitions of vessels abroad have proved not generally abortive, several ironclads, powerful for that day, might have made their appearance on the coast, in which case fortifications would have filled an important rôle. In concluding his volume on France and the Confederate navy, Bigelow says, " Had Amman's ships been ready for sea a year sooner, as by his contract they should

have been, when Mr. Lincoln's cabinet was rent by dissension, and a presidential election was impending, it is not probable that any amount of remonstrance on the part of our diplomatic agents would have prevented their being allowed to embark upon the predatory career for which they were designed. They would not only have opened every Confederate port to the commerce of the world, but they might have laid every important city on our sea board under contribution, the most probable result of which would have been a humiliating peace . . . Had the war continued but a month longer, the Stonewall would have been in possession of Port Royal, and if two months longer, the City of New York would probably have lain at her mercy. One more defeat or one less victory of the Union arms would certainly have given the Confederates one, and probably four vessels, each more formidable than anything that floated the Union Jack."

So far as Confederate activity in England was concerned, vessels of various types were built or contracted for with the avowed purpose of operating on the Northern coast, in addition to blockade runners and those built for operations against commerce. Three of these vessels were especially designated for a raiding expedition against Portsmouth, N. H. Two of the vessels, monitors, were in existence not long ago on the British navy list as the Wyvern and Scorpion. Had any of these vessels appeared on the coast, there seems no reason to assume that they would not have met with the ultimate fate that belongs to the greatly inferior force, and before they could have inflicted much damage. Mr. Bigelow's distressing picture seems overdrawn but there can be no doubt that the danger to the coast-wise cities was real and great. Captain Mahan's words before quoted seem to cut the knot of the difficulty concerning seacoast defenses in assigning the definite place of each element of the defensive system. For an inferior naval power, the policy is clearly indicated also by Captain Mahan: " On the other hand that Napoleon when convinced that he could expect nothing decisive from his fleet accepted the use of it as a means of harassment or of diversion, must be received as a weighty indication of the naval policy suited to the inferior naval power. To assume a menacing attitude at many points, to give effect to the menace by frequent and vigorous sorties, to provoke thus, a dispersion

of the enemy's superior force, that he may be led to expose detachments to attack by greater numbers, such must be the outline of conduct laid down for the weaker navy. But that such a course may be really effective, that the inferior may as in some of Bonaparte's wonderful campaigns, become ultimately superior, there must be at some fitly chosen point of the sea frontier a concentrated body of ships, whose escape if effected, may be the means of inflicting a great disaster upon the enemy by crushing one or more of the exposed fractions of his fleet. Unless there be such a central mass, mere dissemination is purposeless. Inferiority carried beyond a certain degree becomes impotence."

Fortifications are as necessary to the development of such a policy as the fleet itself, the inferior fleet if not sheltered behind fortifications in crises which will arise, may be attacked by a superior force and its efficiency destroyed. The French fleets of the revolution and later lay safely under the guns of their fortifications waiting the opportunity for sortie,—the long and weary watching of the French and Spanish arsenals by the British soon would have been cut short in many cases but for the fortifications, which also played an important part in the preparations of the Boulogne Armada, the boats and transports for which had to be assembled from as far east as the Scheldt to Brest in the west. The coast defense on this line consisted of permanent batteries on all the headlands, with field batteries stationed at intervals able to follow the transports and cover them. The character of the coast enabled these vessels on account of their shallow draft to creep along the shore out of range of the guns of the British cruisers, while the cruisers themselves, were under the fire as it happened, of the superior coast guns. The operation of concentration was of course greatly hampered, extending as it did, over such a long period, but it was not materially affected. The attack from the sea at that time was deemed hopeless on account of the completeness of the defense, at Boulogne alone 500 guns being mounted. Unsuccessful attempts were made at bombardment, and cutting out expeditions were vainly attempted, and in recording the failure of such a cutting out expedition in front of Boulogne in 1801 in which many lives were lost, Lord Nelson wrote that, "all behaved well, and it was their misfortune to be sent on a

service which the precautions of the enemy rendered impossible to succeed in." Lord Nelson was generally disposed to discountenance attacks upon fortified positions, and all the time he was in front of Toulon the three batteries which covered the outer roads were quite insignificant, but the case was just one where he cared nothing for the fortifications except to leave them alone, it was the fleet that they effectually sheltered that was his objective. The Mediterranean coast from Marseilles to Genoa, was provided by Napoleon with defenses so placed and of such a character that his supply vessels could pass along in safety in sight of the watching frigates. Mobile batteries were also a feature of these defenses.

At two different periods in the early part of the 18th century Vigo fell under a combined attack by land and sea. On the second occasion, the formidable character of a citadel enabled the defenders to hold out for eight days before capitulating. The citadel of course, stood for so many more men of the garrison which could not have held out in the open. Admiral Colomb remarks upon this and his words tend to give a still clearer conception of the place fortifications should hold in defensive schemes: "The reflection occurs that the delay was useless, and only caused additional loss to the Spaniards; but that it might have been of supreme importance had a relieving force been in position to arrive before the eight days had expired. As the matter stood, it is impossible to say that Spain was in the smallest degree advantaged by her fortifications of Vigo, though if the strength of the fortifications of Corunna had to do with the changing the objective to Vigo, we have their value exhibited there." *

"The difficult strategical and economical question appears to hinge on relative cost. Was Spain at that time spending on her fixed coast defenses and their garrisons a sum which would have provided a fleet which must be watched before any territorial attacks could be considered by her enemy? If there had been five or six sail of the line at Corunna, Admiral Mighells must have kept his whole force there to watch them, and the accidents of blockade would have made it necessary to have a like fleet

* On the occasion of the last siege of Vigo the attacking squadron had been previously before Corunna and had abstained from an attack.

with Lord Cobham's transports. If it had been necessary to double the naval force employed on the expedition, would it have been contemplated at all? History seems to bring these questions before us as of everlasting practical importance." The English extremists would probably not be willing to strip Portsmouth, or the Thames, or other points, of their guns if the question were put squarely to them.

The fraction of the inferior fleet taking the sea for the purpose of creating the menace runs the chance of its speedy destruction unless it disperses, each unit bent on doing all the destruction it can in its perhaps short-lived career. According as its work of threatening or of destruction is better achieved through attacking commerce, or menacing the littoral, its operations will be governed. If the main body of the fleet avails of positions, strategically good both for entrance and exit by evasion, and holds itself in hand watching for any chance that may transpire to equalize its strength with one or more fractions of the enemy's fleet either through accidents, mistakes, or the compulsions of the situation, it will be in a far better position if covered by coast defenses. An inferior fleet in Long Island Sound, for instance, would be little better off without coast defenses than if it were in the open, except for the great advantage conferred on it through the two exits. In Chesapeake Bay it would be no better off, experience going to show that a fleet attacked at anchor or in a confined space is taken at a great disadvantage, unless covered or supported by fortifications, and even then the dispositions for mutual support must be most skilfully made. The torpedo vessel has made the position of an anchored fleet most perilous.

It is certainly wrong that upon a single military arm should be laid the task of defending the coast. It being admitted that the first fighting line should be kept as far from the coast as possible, that is, on the enemy's coast,—the contemplation of the fact that from any cause it will be unable to entirely occupy the enemy's fleet brings at once to the mind coast defenses. In other words, the so-called first line of defense should not be the only line of defense. On the other hand, to repeat, it is somewhat difficult to see what essential part seacoast fortifications could play in defense if there was no fleet. The paramount relative importance of a fleet in a system of defense is frequently

lost sight of, and people in some way get the idea that fortifications by themselves in a way add to our stature or strength,—that they can do something in fact. Yet the whole coast might be made to bristle with guns, and still not add to the impressiveness of an international demand. The addition to the naval strength, however, of a few battleships has a remarkably far-reaching and persuasive effect. It is certain that our fortification schemes are simply noticed by foreign nations, while our naval policy is keenly watched. Though the coast of Belgium is clad in iron, it is difficult to see why, unless it is allowed that certain contingencies calling for alliances are looked for. But so far as national defense is concerned by that nation alone, all those fortifications are but so many tons of iron. They, however, may be but the part which Belgium contributes to the general European guarantee of her neutrality. In another sense perhaps, permanent fortifications possess a fictitious value in the minds of the peace-loving peoples. The doctrine of minding one's own business or of non-interference, engenders the spirit of passive resistance of which fixed defenses are the exponent. Our peace-loving nation may be content to rest behind such defenses, forgetful that an attitude always passively defensive is bound sooner or later to give way and break down. The most cautious, if able, general, on the defensive, simply waits the opportunity to assume the offensive, which in his hands becomes the most perfect defense, and it may further be said that to assume a merely passive defense on the ground that an active offense is hopeless, simply allows an enemy to gain his objective, eventually, with much less material loss. When a fleet covers itself behind passive defenses, the enemy has already gained much that he should have been compelled to fight for. In the national policy for defense, the permanent defenses and the mobile defenses should be grouped together and should go hand in hand. There should be no separation in their interests or in their treatment, as there is none in fact; and this consideration leads to the conclusion that all the means conducing to national defense should be treated by the same general head, not necessarily by one person, but there should be a community of interests secured by a common supervision. In the case of powers having a colonial policy, the relationship is perhaps more in evidence than has heretofore been the case with the United

States, where the sea frontier, until recently, marked sharply the line drawn between the two arms of the service. As regards over-sea colonies, it is impossible to separate their defense from a consideration of the naval forces. A coaling station has no reason for existence except as a depot for the fleet.

It may be of interest to examine into some of the causes which occasionally gave such brilliant and signal success to vessels opposed to fortifications, as bearing upon the complete and radical change which has taken place in the principles of placing and construction of coast batteries.

The evolution of the coast battery may without sensible error be assumed to have been something after this manner. First a gun or guns placed at the water's edge as low down as possible, with the object of attaining the full effect from the ricochet of the spherical projectile, as well as to increase the accuracy of the fire of the guns by getting as close as possible to the ship; the range and danger space by this means being enormously increased. The number of guns increasing, a desire for economy and concentration placed the guns in one work, and the same reasons added tiers of guns to the battery. There was also present the idea of repeating in the battery the well demonstrated offensive powers of the many-decked ship, and such a combination formed, at that time, greater defensive properties. Single tier batteries at the water's edge were frequently commanded by the upper deck guns of the heavier ships. The concentration of the guns of the day, with all their inaccuracies, in one position gave these batteries chances of inflicting damage at their effective ranges, which ranges being extremely short, enabled the batteries to be more easily defended from a land attack. The same held true with the ship. If a line-of-battle-ship of the early years of the century could range up to within point blank of such a work unmolested, and anchor, the amount of metal she could deliver with every projectile hitting, was remarkable. In the case of a 100-gun ship for example, a few figures will illustrate. Such a ship as the Queen Charlotte, in 1794, would carry on the main deck thirty 32-pounders, on the second deck twenty-eight 24-pounders, on the third deck thirty 18-pounders, on the quarter deck ten 12-pounders, and on the forecastle two 12-pounders. In addition, such ships in the

British navy always carried from eight to ten carronades, usually 32s and 34s, six of the latter and two of the former. The total weight of metal that a 100-gun ship could throw in a broadside was 1292 lbs., and it was reported a common performance to do this once in a minute. It follows that in five minutes she could deliver, against larger fortifications with every shot telling, 6460 pounds of metal. This rate of fire is commonly assumed to have been practicable in those days, but in Collingwood's flagship, the Dreadnaught, before he took the Royal Sovereign on the eve of Trafalgar, it was thought good work to fire three well aimed broadsides in five minutes and a half. Well aimed broadsides, however, were hardly required when a vessel could be laid within from 100 to 500 yards of a large masonry fortress. It was impossible under such circumstances to miss the work, at such ranges every shot told, and in many cases vessels had been permitted by coast batteries to take such positions favoring them in the extreme. The Queen Charlotte engaged within fifty yards of the batteries at Algiers in 1816.

A comparison of the fighting efficiency of the old type line-of-battle ships with those of the present day may not be amiss in this place, especially having regard to their comparative efficiencies when brought in contact with coast works. It goes without saying that the old ship has no place to-day against proper coast works, even though she were a steamer. But it is a matter open to serious question if she were not, in her day, relatively more efficient in such actions than the present battleship. While perhaps no greater rapidity of fire was attained in the time of the Crimean war with the same type of guns than in the beginning of the century, nor had the number of guns increased, yet the volume of metal thrown had decidedly increased. The Caledonia of the later date carried 120 guns; twelve 8″, firing 56 pound shot, and one hundred and eight 32-pounders. She was able to deliver at a broadside 2064 pounds of metal. The Victoria, a screw steamer of the same period, carried 121 guns all told; sixty-two 8″ or 56-pounders; fifty-eight 32-pounders; and one 68-pounder pivot; thus firing in one broadside 2732 pounds of metal. Our first frigates built after the War of 1812 threw a broadside of 2406 pounds. A comparison of recent battleships, where figures are available, will bring out some significant facts. It will be noticed that the number of larger

sized rapid-fire guns supplied to the more recent vessels exhibits a decided tendency towards a return to the efficiency peculiar to the old ship, in which rapidity and volume were gained by numerous guns, and accuracy was obtained by fighting at short ranges. Taking the Irresistible, for example, which on a displacement of 15,000 tons carries four 12″ guns, twelve 6″ rapid-fire eighteen 12-pounders, twelve 3-pounders, and eight machine guns. Assuming five minutes as the unit of time, the number of rounds that could be fired would be for each gun approximately as follows: 12″ guns, one; 6″ guns, twenty; 12-pounders, thirty; 3-pounders, fifty. This would permit a delivery of six hundred and ninety-four shots and 19,540 pounds of metal in five minutes. The Victoria in that length of time could probably have delivered nearly five broadsides of 13,660 pounds of metal, the number of shots being 305, which is not such a wide difference as might have been imagined.

The draft of water of the old ships, especially the English, did not differ greatly from that of the present battleships of the second class. The displacement, however, was much less. If the vessels of the two epochs be compared by displacements, the balance in favor of the old ships would be very great, indeed, so far as the volume and intensity of fire at effective ranges goes.

If it is allowed that the 12″ guns of the Irresistible can be aimed and fired once in five minutes, it would probably be an average performance. The twenty-nine ton gun cannot fire more than twice in the same time. The hand worked gun on the Thunderer of the same size (29 tons) fires in practice, once in one minute and ten seconds, unaimed rounds however. The 6″ guns, not rapid-fire, do very well firing once a minute, better than ordinary practice shows. Twelve times a minute is a very favorable allowance for the 6-pounder and 3-pounder. Of course a comparison with the most recent ships would show a great advantage over the old ships, as the number of guns and the rapidity of fire have greatly increased. The battleships of our latest class will carry perhaps seventy-four guns, all of them rapid-fire except the turret guns,—but the comparison made, however, will serve to make clear how very efficient the old ship was against fortifications in plain sight at short range, while the modern ship must contest with almost invisible defenses at greater ranges. Another interesting comparison has been insti-

tuted by Lieutenant-General Pestitch of the Russian Marine Artillery, which tends to convince us that the old arrangement made a ship a more efficient fighting machine relatively speaking, apart from the considerations I have tried to give, than the modern battleship. He takes as his base of argument the proportionate weights of artillery compared with the other features of vessels, and from such an examination of his figures as was possible, there is no doubt they are very accurate. For instance, before the beginning of the present century the proportionate weight in tons of artillery to displacement in the case of a 100-gun English ship, he states was 23 to 100; later, it fell to 21 to 100, and later still, in the case of the Paris in the fifties to 18 to 100. In modern English ships the variation in the types is great. In the turret class of English ships it varies from 8 to 100 to 4 to 100, in citadel ships from 8.8 to 100 to 5 to 100. For protected deck cruisers from 6.5 to 100 to 5.5 to 100. The French ships show nearly the same percentage. The nine largest Italian ships are stated as carrying 11 tons of ordnance to 100 tons displacement. The figures are difficult to arrive at upon which to base accurate calculations, but when we consider the nature of modern fortifications, wherein it will be necessary to hit small objects with but short intervals of appearance, and only occasionally will large heavy targets be offered, it may be said in general terms that the ship, which is provided with a rapid-fire battery up to the utmost limits of weight which the conditions of rapid-fire impose, is better fitted in the sense of offensive power to cope with coast works. The tendency in modern ship construction is certainly in that direction. The heaviest guns are being decreased in size and weight towards the limit imposed as condition of rapid-fire, and the lighter guns are increasing in size and weight towards that limit. As we take the still later designs of ships, the results are very apparent. The five minute fire of the Royal Sovereign which can be directed on one point is approximately 17,000 pounds; that of the Marceau 14,644 pounds; the Iowa 12,500 pounds, the Woerth a little less. The Jaureguiberry, however, having but three heavy guns in broadside, falls to 8818 pounds, and in the Iowa we have better results than in the monstrous Italia of an older date, by about four hundred pounds. A few illustrations, though they cannot be taken without suspicion, will corroborate General Pestitch's figures.

The Warrior class of vessels were allowed 400 tons for ordnance on a displacement of 7256. The Blake of 9000 tons allows but 486, the Duillio on 10,401 tons, 984. The Riachuelo of 5685 tons displacement was allowed only 300 tons for ordnance, meaning guns, small arms, turret engines, hydraulic apparatus, and other gear, while the weight allowed in the old Victoria for guns and carriages alone was 357 tons. Formerly, the whole ship was a gun carriage, the motive power not interfering with the artillery in any sense except in that of its weight. No gun space was occupied by the motive power. The necessity for carrying coal, machinery, and armor has reduced the weight permissible for artillery. All economic improvements giving extra allowances, the General claims has gone to armor and big guns, and to increasing the speed. By weight of artillery in his calculations is to be understood the total allowances for ordnance. The General was present at Sebastapol and thinks the vessels would have done better with a larger number of smaller guns. As regards the efficiency of a vessel in attacking coast works, speed is the last factor to be considered. The one great thing is the effect produced by an intense and accurate fire from many guns.

History recounts but few instances of the single-handed engagement between a ship and a fort. The fort was usually outnumbered greatly in gun strength, and, further, in the engagements that have taken place between ships and forts, there has generally been a noticeable difference in the fighting efficiency of the personnel of the two sides. In our Civil War the conditions were somewhat different. There was a perfect equality in the temper of the opposing parties. The most brilliant achievements of vessels against coast defenses, were the simultaneous passage and silencing of fortifications or the passage alone in the face of inefficient obstructions. In other respects, fortifications proved again and again their superiority and efficiency, and frequently, perhaps always, it was the improvised works, fortuitously placed while supporting each other and stubbornly fought, that gave the best account. In some cases, the powers of resistance of simple earthworks à fleur d'eau were remarkable, especially when pitted against the slow firing monitors. Even when the odds have been greatly against the works on shore, there have been few occasions where the success of

the fleet cannot be traced to the inefficiency in numbers or temper of the defenders themselves. The Southerners set themselves an impossible task and many people are prone to-day to set themselves the same task. The effort was made to fortify every vulnerable point of the coast line, and with their own resources and those secured in the navy yards in the South, they were able to make a showing to that end. The result was that their efforts were disseminated over the whole coast line, and naturally they could not be strong at all points. Every point was thus weakened in personnel, and when the strain was brought at one or more points it was generally impossible to relieve it. Greater powers of mobilization would have helped matters in respect to garrisons, but a more concentrated system deliberately worked out would have been more rational and, it cannot be doubted, more effective.

An examination into the circumstances surrounding a few famous engagements between ships and coast defenses, more particularly those wherein the ships have been successful, may serve to elucidate the principles of coast attack and defense involved. Of course conditions have changed, but perhaps not to so great a degree relatively. At any rate, experience is the only guide we have, and when we find history telling us that the cases wherein ships without the landing force have been successful over coast defenses, are the exceptions and that there is a long line of successes the other way, an investigation of the events can only aid us to form proper ideas concerning such actions, and properly to estimate their risks and chances under new conditions.

In Lord Exmouth's famous action at Algiers in 1816, though the opponents were wary and skillful, he was permitted, unmolested and before a single gun was fired from shore, to anchor his flagship by the stern,—lashing his vessel, the Queen Charlotte, at the same time to an Algerine brig at anchor and within fifty yards of the mole batteries, his whole fleet following into its position. In taking its position, the whole fleet was compelled to pass under a range of powerful batteries. The position the flagship was allowed to take, enabled her to enfilade the whole line of bateries on the mole. The engagement which lasted from 2.45 to 11.30 P. M. resulted in what was called, and was in fact, a brilliant victory for the fleet, but it may be and has been

questioned, if people of a different temper than the Algerines would not have changed the course of the affair. The first error committed by them was in permitting the fleet to take its fighting position unmolested, while it could have been under fire at all ranges in the position most unfavorable to it; i. e., while it was approaching end on to take position and when it could not return the fire. The whole number of guns mounted throughout the city both for land and sea defenses amounted to probably more than 1000, though it cannot be ascertained that more than 320 could be brought to bear on the fleet. The possibilities are that not more than 200 bore. The Algerine men-of-war inside the mole were four 44s, five 24s, or 30s, and a number of gun and mortar boats. The allied fleets mounted nearly, if not quite, nine hundred guns and comprised a number of gun- and mortar-boats, and special vessels for firing Congreve rockets which succeeded in destroying the Algerine vessels and setting fire to the arsenal and other buildings. At 10 in the evening, the commander-in-chief seeing that the batteries around his division were "in a state of perfect ruin and dilapidation," determined to withdraw and says, "Providence at this interval gave to my anxious wishes the usual land wind common in this bay, and my expectations were completed. We were all hands employed warping and towing off, and by the help of the light air, the whole were under sail and came to anchor out of reach of the shells about two in the morning."

James says that the upper tiers of the batteries were in a state of dilapidation, the fire from the lower tiers nearly silenced, and the ammunition of the fleet short when it commenced to withdraw, he also speaks of the wind which "fortunately for the British had just sprung up." The Algerines gave in to the demands of the British the next morning without further resistance. The allied loss was 144 killed and 742 wounded. The Algerines' loss estimated at from 4000 to 7000.

Lord Exmouth speaks of a little battery on the upper angle of the city on which the guns of the fleet could not be brought to bear, which annoyed the ships. The fleet in this action expended 500 tons of shot. The Queen Charlotte from her close position so kept down the fire of the opposing batteries that her losses were very slight comparatively, eight killed and 131 wounded. The Impregnable at from 1200 to 1500 yards, how-

ever, suffered severely, there being 50 killed and 138 wounded, the vessel besides was seriously damaged, and only those vessels that were able to close, silenced their opposing batteries. The tactics employed were to pit ships as closely as possible against a portion of the sea forts, the mortar vessels being held at about 2000 yards distance. Through untoward circumstances it was impossible to fully carry out the plans, hence the position in which the Impregnable found herself.

When Napoleon at St. Helena heard of this engagement, he said to O'Meara that the matter might just as well have been settled by blockade. "There are no other seamen (except the Americans) who would have done what yours (the English) effected, or perhaps have attempted it. Notwithstanding this, and that you have succeeded, it was madness and an abuse of the navy to attack batteries elevated above your ships, which you could not injure; to contend against red hot balls and shells, and run the hazard of losing the fleet and so many brave seamen against such canaille." Napoleon all his life gave especial attention to coast armaments and organizations.

The light wind which happily sprung up for the fleet, undoubtedly was a large factor in the ultimate success. So far as it is now replaced by steam, just so much more certain may the results be considered. The ability conferred by steam propulsion to withdraw at such decisive and critical moments is an incidentally great advantage for the attack, so long as the power to move at will remains.

Some thirty-nine or forty gun-vessels took part in the struggle on the Algerine side, as harbor defense vessels. When they could be made out through the smoke, thirty-three of them were promptly sunk by the superior fire from the ships. In the lack of much historical data as regards the efficiency of gunboats in coast defense, this item is given for what it is worth. It is pertinent to imagine what more the fleet could have accomplished if the Algerines had not given in without further resistance. Close action was absolutely essential to the fleet,—and there are many indications that the same holds to-day,—and its ammunition was dangerously low, immense quantities had been used, and the result was that the fleet was thankful to get out of range.

At Acre in 1840, the British fleet under Admiral Stopford was

allowed to sound, lay buoys, and take its chosen position unmolested. The tactics pursued were similar to those in Algiers, to attack on two sea faces, leaving some of the batteries masked. This victory was rendered easy from the very weak resistance offered. It is not necessary to detail the circumstances further than to quote the opinion of the Duke of Wellington concerning it, that "this was a singular instance, in the achievement of which great skill was undoubtedly manifested, but which was also connected with peculiar circumstances, which they could not hope always to occur. It must not therefore, be expected, as a matter of course, that all such attempts in future must necessarily succeed." Another successful operation of ships against forts was that of San Juan d'Ulloa, reduced in 1838 by Admiral Charles Baudin. The work of San Juan d'Ulloa was a rectangular, bastioned, casemated fort on the edge of the reef of Gallega, facing the City of Vera Cruz, and separated from it by a narrow strait, 1000 yards broad, and about 20 feet deep. Another narrow channel on the opposite side separated the reef from the small narrow island of Galleguilla. The fortress was built in regular fashion, and mounted one hundred and ninety-three guns. The squadron consisted of the frigates Nereide, 52; Gloire, 52; Iphigenie, 60; corvettes Creole, 24; Naiade, 24; Gabare, Sarcelle; bombardes Cyclope, and Vulcain. Reconnoisances were made by night, under direction of the admiral, the parties approaching very near the fort. The best place for the attack was chosen where the water was calm and the fleet would be under the fire of a minimum number of guns.

The bomb vessels having arrived on the 27th of November, 1838, the Nereide and the Gloire were towed into their positions under sail at about 1300 yards northeast of the work, within about 100 yards of the edge of the reef. The bomb vessels Cyclope and the Vulcain were towed between the two reefs, anchoring at a distance of 1600 yards from the work. The Creole was allowed to fight under sail. The Naiade and Sarcelle were placed to the northward to observe the fall of the projectiles and correct the ranging, in the trial shots. The three frigates were so placed that only the small number of twelve guns could be brought to bear upon them. They were allowed by the Mexicans to take their positions deliberately and to spring their broadsides into the most favorable position. The action was

commenced by the frigates at about 3 P. M. The wind was very light, and after a short time the works and the ships were covered with smoke, compelling a cessation of fire on the part of the vessels. The corvette under sail, the Creole, found it difficult to keep in position in shallow water, and she was moved into the channel between the two islands and continued the action under sail. About 4.30 some mortar shells from the vessels caused the explosion of a magazine as usual, and caused the batteries in the neighborhood to cease, after which the fort fired only occasionally. In the evening the fort asked for a suspension in order to care for the dead and wounded. This request was refused and the capitulation of the fortress was demanded under threat of renewing the bombardment in the morning. This proposition was referred to the Commandant at Vera Cruz, and while the fleet were getting into position again the next morning the terms were accepted.

It is unnecessary to look further into this action. It was undertaken by Admiral Baudin, at a time when all the world believed the works impregnable in an action with ships. His biographer says that the mortar shells broke in the roofs of the magazines, that the fire from the batteries was continuous, and that the explosions alone carried discouragement to the garrison.

The French chief of engineers noted that there was no breach in the scarps, and that none of the casemates had been broken in; and that, at the moment of capitulation the frigates were upon the point of retiring. He says that, "The besieged should have seen that we were unable to breach the walls or to destroy their casemates, and therefore, our inability to take the fort by a simple bombardment." It seems that the principal magazine was intact.

The Duke of Wellington is reported by the same biographer as having said that it was the first instance he had ever known of a regularly fortified place having been reduced by a purely naval force. It is probably a misquotation in the face of Lord Exmouth's affair at Algiers in 1816; and two years later the affair at Acre took place upon which he expressed himself as previously quoted. The wonder is that the attempts succeeded at all. The crews of Admiral Baudin's fleet were weakened by yellow fever and the stringent need for water, and the material odds were all against him, but whether the Mexicans fought well or ill, the action of the admiral was notable.

The siege of Charleston, beginning in 1863 and continuing to 1865, is replete with interest, but the subject is very controversial and somewhat indeterminate. It has been stated that the iron-clad fleet could have gone up to the city at any time, that the character of the obstructions were such that they would not have prevented the fleet passing through the lines, and that the three, successive centres or zones of concentrated fire so much relied upon by General Ripley, could also have been successfully passed. The question in that case is what would the fleet have done when it arrived off Charleston city. The batteries would still have been in existence in its rear.

Captain John Rodgers of the Navy expressed his opinion on that point very clearly before a senate committee in February 1864. "Ordinarily and popularly, to take a place means to take its defenses. General Gillmore was forty-eight days on Morris Island, acting against Fort Wagner, with some 10,000 or 12,000 men against a garrison of about 1500, more or less, assisted by the monitors and by artillery which excited the wonder of Europe. . . . He took the place, not by his artillery nor by his monitors, but by making military approaches and threatening to cut off their means of escape and take the place by assault; and when he took it, it was not so greatly damaged as to be untenable.

"Now, if General Gillmore, on the same island, assisted by his artillery and the whole force of monitors in forty-eight (or fifty) days, could not capture Fort Wagner alone by them, it is perfectly certain that the monitors alone can never take the much stronger defenses which line James Island and Sullivan's Island. In going up to Charleston therefore, he would have to run by the defenses, and leave the harbor, so far as they constitute the command of it, in the power of the enemy; and when he got up to the city he could not spare a single man from his monitors even if they should consent to receive him; and if he burned the town, he would burn it over the heads of non-combatants, women and children, while the men who defend it are away in the forts. I should be reluctant to burn a house over a woman's and child's head because her husband defied me. Dahlgren if he burns Charleston, will be called a savage by all Europe, and after the heat of the combat is over he will be called a savage by our own people. But there are obstructions in the way which render

it doubtful whether he can get there, and if he goes up under the guns of those fortifications, sticks upon the obstructions, and is finally driven off by any cause, leaving one or two of his monitors there within their power, they will get them off, repair them, and send them out to what part of the coast they please, and give a new character to the war.

"The wooden blockade will be mainly at an end, unlimited cotton going out, and unlimited supplies coming in. I see no good to compensate for that risk, except it be in satisfying the national mind that retributive justice has been done against the city of Charleston. . . . In a word I do not think the game is worth the candle. Whether these reasons operate with him, I do not know, they would with me."

Leaving aside all the disputed points it is perfectly certain that the fortifications were too much for the fleet alone; that the landing force actually engaged, until the approach of Sherman's army, was inadequate, and that the nature of the country precluded the possibility of taking the city and works by a flank march. Could a sufficient body of troops have operated in such manner on the communications of the line of defenses, the place must have fallen.

One other engagement between ships and shore defenses will be noticed, not for its value as a study which is very great, but from the notoriety it gained, and the influence it had upon the character of coast defenses. The one referred to is that in which the Pompee of eighty guns, Sir Sydney Smith, the Hydra, thirty-eight guns, and the Aurora, twenty-eight guns, engaged in 1806 for a considerable time a small two-gun round tower battery placed well above the level of the sea at Cape Licosa. The Pompee fought at anchor at a range of 800 yards and the other two vessels fought under way. The battery was manned by twenty-five French soldiers commanded by a Lieutenant, a Corsican relative of Napoleon's. At the second round from the battery one of the two guns was dismounted and was afterwards fired resting on the ground. The ships nearly exhausted their ammunition. The Pompee was hulled forty times, her mizzen topmast was carried away, seven were killed and thirty wounded. A small detachment of marines supported by two small field pieces went ashore and the work capitulated.

These examples taken at different periods, illustrate rather

fairly the conditions under which such engagements between fleets and forts have taken place in the past. The three of Algiers, San Juan, and Acre, are a few cases, wherein the fleet has succeeded unless the landing force has appeared. There are many cases where the great power possessed by a few guns with weak cover has made itself felt. As a modern example of this, there is the very recent one of the bombardment of the fortifications at Santiago de Cuba. These consisted of four 15 cm. Hontoria B. L. Rifles, several machine guns and a few very old bronze smooth bore guns which had been rifled to fire a shell of about seven inches, and five muzzle loading 8″ mortars. The works were constructed of barrels and boxes filled with concrete reenforced with earth forming the faces of the forts—yet they withstood the repeated attacks of the blockading squadron which for the greater part of the time consisted of the first-class battleships Oregon, Indiana, Massachusetts and Iowa, the armored cruisers New York and Brooklyn, with the addition at other times of the protected cruisers Newark, New Orleans and Marblehead, the auxiliary steamers Dixie, Suwanee, Vixen and Gloucester. It is true that none of the bombardments were expected to destroy the works or to force a capitulation, but only to harass the enemy and do him as much injury as possible. The ranges used varied from 2000 to 3000 yards, and with the exception of knocking one gun off its carriage; temporarily disabling another, and generally burying the remainder under the earth thrown up by the exploding shells, no damage was done which was not immediately repaired.

Wherever there has been anything like an equality, however established, especially in the personnel, fortifications have had a remarkable history of success; and there are authentic accounts other than those given, in not very distant times, which are almost incredible, tending to exhibit the remarkable superiority of guns on shore. In such cases also an equality in the character of the personnel is to be noted as well as the fortuitous placing and character of the battery. All these instances taken with the known reasons have induced engineers to place coast works, whenever possible, so that they shall have a distinct command. The single reason before stated in favor of low placed batteries, that of increasing the range and dangerous

space through ricochet firing, in the smooth bore era, has with modern ordnance a parallel now in the desire to deliver a direct heavy armor-piercing blow,—but up to certain limits, high command favors that as well. The reasons for giving high command to guns are many, and have regard both to the offensive and defensive character of the work. The target offered is greater in area, there are more chances of a deck hit at all ranges; and one reason, flowing from the immunity offered by high sites, is the unrestricted arc of fire thus secured. The most urgent reasons, however, have to do with defense and the security to the gun detachments.

The naval wars of recent years have decisively settled the point that earthworks are the very best cover. Experiments, in addition, have confirmed the results of experience. Masonry has had its day and the expedient of facing masonry with armor is not favorably looked upon by engineers, although the rigid backing offered by the masonry seems to increase the resisting powers of the armor applied to it. It is doubtful if such armor faced batteries will ever be constructed in the future, though existing casemates, well placed according to modern requirements, may be utilized in that manner. Casemates have many objectionable features peculiar to that form of battery; the restricted arc of fire permitted by the embrasures, the difficulty in aiming, the accumulation of smoke in them, the limit to elevation, their expense, if made of sufficient resisting powers, their weakness about embrasures, and the exposure of the chase of the gun during the entire time under fire. On commanding sites they are not necessary. In places where such sites are not available, recourse may be had to various other methods of mounting guns under cover. Among all the different methods proposed, there are but a few general types. Casemates, turrets, disappearing mounts, and barbettes with or without shields. Turrets are open to the same objections as casemates. They have, however, the advantages of an all around fire, and offer the most complete protection to the gunners. The fact that two guns mounted in one turret operates to lessen the item of cost as compared with efficiency. The cost, however, remains enormous, and turrets should be resorted to only when no other method can possibly be made available.

At a time when heavy guns and turrets were in form, a Mr.

Anderson, C. E. stated his belief, in a lecture before the R. U. S. I., "That the Dover turret would be so damaged by a single 16" shell that it would be impossible to work it any more. The energy of one of the bolts of the Inflexible striking, say at 2000 yards range, would be represented by the whole of the Dover turret, which weighs 750 tons, rising sixteen feet in the air. Is it conceivable that no derangement would result from such a blow?"

The effect of a blow upon the chase of a turret gun delivered on its side, through the leverage, in putting out of action the turret and guns has not been considered, however. Disappearing mounts are of many different descriptions, and present many distinct advantages, together with some disadvantages. The problem of their application to the heaviest ordnance has been satisfactorily solved. They are relatively much less costly than either casemates or turrets. The personnel serving them is as perfectly shielded as possible. The gun itself is only exposed for the instant of firing, and they are applicable to all sites. Apart from the moment the gun is exposed, the only target offered is a horizontal one, completely invisible from any position a ship can occupy, and in conjunction with a horizontal shield the gun can hardly be injured. The arc of fire can be made sufficiently wide, and any elevation desirable can be used. On the other hand, guns so mounted require the most complete application of every system of range and position finding, and the utmost nicety and precision in their action. Earthen barbette batteries possess all the advantages of the others with the exception that the gun is exposed more to direct hits from all calibres of guns, and on low sites the difficulty in the way of covering the gunners is very great, but by applying horizontal covers, the protection is considerable. It is evident that the greater the I. V. the more the range will have to be increased in order to obtain even a hit against any part of a gun so mounted, let alone the carriage or its detachment. With an angle of fall of 4° the shell, or projectile of any kind, would strike the ground with a height of parapet of 10′, at a distance of but little less than 144′ behind the parapet, and at only 72′ from the crest would the projectile pass within 5′ of the platform on which the men are stationed. In order then, to obtain any serious results against a gun so mounted, other than a hit on the muzzle or

chase of the gun, or the weak point of the crest the ship must remain at a distance.

It will be interesting to note a few figures taken from a series of curves designed by an English naval officer as illustrating the value of high sites for barbette batteries. The gun was a 27 C. M. (10.6″) French B. L. gun. The shell was of 476.2 pounds weight, the i. v. having been 1664 f. s.

Height of Battery.	Range.	Angle of Fall.
100′	500 yards	+4°
	1000 "	+1°
	1300 "	Horizontal
	2130 "	—2°
	3030 "	—4°
200′	1720 yards	Horizontal
	2640 "	—2°
	3170 "	—4°
240′	1860 yards	Horizontal
	2590 "	—2°
	3350 "	—4°

For a battery elevated 100′ above the gun, the shell fired at a range of 500 yards will arrive at the crest with an angle rising of about 4°.

The increase in velocities and flatness of trajectories has operated in some ways to reduce the danger to be feared from shrapnel fire. In the first place in order to be effective against such a work the shrapnel must burst at one particular instant before and over the parapet. The increased velocity has manifestly decreased the chances for such a burst, which was always a matter of great uncertainty, and again, borrowing from other English experiments and writers, the results of experimental shrapnel fire with H. P. B. L. rifles give angles of opening for shrapnel fired from a 12″ B. L. R. at 2000 and 3000 yards as 4° 34′, and 4° 40′ respectively. Taking the case above of an angle of fall on arrival at the crest of 4°, which could only be the case with a range of 3170 yards for a battery elevated 200′ (this for a 10.6′ gun, however) the lower branch of the cone of dispersion would have an angle of fall or drop not greater than say 4°+5° =9° and only at 32 feet inside the parapet would be shot pass within 5 feet of the platform. These results of course would

show an increase or decrease in proportion to the initial velocity of the projectile. By the proper placing of such an earthen battery, it can be given a wide arc of fire, and be very little subjected to a raking fire. The thickness of earth necessery to keep out all projectiles and to prevent the craters formed by the explosion of shells in the parapet from destroying the crest when the slope is at a proper angle, is variously estimated at from 30′ to 70′. Of course when earth is at hand of proper quality no limit is placed upon the thickness. The bombardments of Alexandria and of our own war furnished all the data needful when combined with extensive experiments carried out in England and elsewhere. A certain kind of loam or crystalline sand seems to offer the best substances. The only hits upon such a parapet that are supposed to be effective are those of shell exploding just on or after striking the crest and throwing in on the gun detachment all the dirt and debris, and for such hits the flat trajectory is not adapted, as it tends to bring the effect of the shell along the line of greatest resistance.

Concerning penetrations into earth works Major Clarke says: "Tables of penetration into earth and sand have found their way into various text books with no words of qualification. It is hardly too much to assert that they are totally misleading. Whatever may be the penetration obtained in specially constructed butts, or arrived at by calculation open to objection, it is now sufficiently established, that parapets of earth or sand with exterior slopes, will not hold projectiles so as to enable them to penetrate properly. At Alexandria, the penetrations judged from a large number of examples, were extremely slight. The shells turned up at once and either ricochetted high over the works, or were stopped and lay on the superior slope base to the front. A 16″ shell from the Inflexible, fired at under 2000 yards range was stopped after penetrating less than 20′ of sand. As might be expected, this tendency to be immediately deflected is still more marked in the case of the new B. L. guns at Eastbourne, an 8″ B. L. Palliser shell fired at 1193 yards gave a penetration of only 6′ into a loam parapet with an extreme slope of one in two. At Lydd, the effect of three 9.2″ B. L. Palliser shells fired at 1200 yards against a similar parapet, was almost nil." While on this subject it is well to recall what Captain Goodrich has to say concerning the earthworks,

as what he has said has exerted a powerful influence upon the consideration of the subject; "There can be put two targets at which it is worth while to direct their (vessel's) fire. The first is the muzzle of any gun actually served; the second is any building known or believed to be a magazine or shell house which is visible above the parapet." Rear Admiral Lord Charles Beresford says regarding the action at Alexandria, especially about Fort Mex: "A barbette fort is the most difficult one to hurt because to hurt it, you must put its guns out of action, and where you have only a gun pointing over the top of the fort you have to put your shot into the muzzle of that gun to put it out of action. If he is firing at you all the time it rather disconcerts your aim, and your shot will either hit the parapet or go over the top."

Apart from the almost universal experience in the Western rivers of our vessels when engaged with high placed batteries, there was an instructive brush which has been widely quoted,—that at Drury's Bluff on the James River, several miles below Richmond, in May, 1865. The bluff was about 200 feet above the river and the batteries mounted three Rodman guns (8″) bearing on the river, commanding a long reach of the river, in which two lines of obstructions had been placed,—a row of piles and sunken vessels. The Galena and a monitor anchored within 600 or 800 yards, the monitor nearer at first, but she had to withdraw to a position where her guns could be given sufficient elevation. The three wooden gun-boats anchored at 1300 yards distance. The action lasted nearly three and one half hours, at the end of which time the ammunition of the vessels was exhausted. The Galena suffered severely, both in her hull and in losses among the crew. The works do not appear to have suffered but slightly. Of course, to repeat, there are many localities which do not afford sites favorable for earthworks with command, in which case resort must be had to other methods of mounting and cover.

In view of the many advantages offered by the disappearing system, turrets should only be resorted to where no other possible method can be used. Where a work is required to be built on a low site, surrounded by water, or where it is thought necessary to place a work even where the site is under water, no other form of fortification seems available. One drawback

to a high site is the dead angle in the space in range nearest the gun, because when the height of parapet is increased to further protect the gun and detachment, this dead angle becomes greater as the depression of the gun is more restricted. In positions where the channel leads at some distance from the height upon which the battery is placed, it can be disregarded. Where the water is deep under the battery, the situation requires the careful consideration of the engineer. Where the surroundings are such that a low piece of land lies between the foot of the height and the water, the engineer must carefully weigh the relative advantages existing between a high battery well withdrawn or a low battery further advanced.

Concerning the question as to whether the guns should be grouped or dispersed in coast defenses, the modern practice is to separate them to such an extent that their mutual support is not endangered. Heretofore, questions of economy and the security of the garrison against a land attack or a coup-de-main, have kept the guns concentrated in the neighborhood of a keep or redoubt. Now, by dispersion within the limits of mutual support, the important feature of invisibility is enchanced; the injury of one battery does not entail disaster to another, and improvements in communication, observation, and range finding together with the accuracy of modern ordnance have neutralized all the advantages which were formerly secured through concentration of material. The smoke of one battery does not mask another battery or reveal its position. The dispersion of the batteries also favors cross fire, and a vessel may find it impossible to take an advantageous tactical position, for when end on to one battery it may find others engaging it on its broadsides. If the muzzles of some of its guns are presented to one battery, forming the minimum target, others may be exposing their chases to damage from another battery. In regard to the importance of invisibility for gun mounting in shore batteries, one British official report concerning the Alexandria bombardment states that, " One rifled gun in the hospital earthwork which it was impossible to dismount, being invisible from the ship, did us great damage." Captain Goodrich also states that the British gunners were greatly aided in their pointing by the contrast between the black muzzles of the Egyptians' guns and the light color of their masonry parapets.

Speaking of this feature of placing of batteries, it is authoritatively stated that the Malakoff battery gained greatly in efficiency after the tower which gave it its name had been reduced to a shapeless mass. While it existed, it was a mark for aim and a constant danger to the battery beneath.

The tactical discussions as to the influence of smokeless powder in future engagements, whether the attack or the defense will be most benefited, while interesting, hardly seems to be pertinent as between ships and forts. Whether the ships will or will not be benefited by its use is also unimportant in view of the immense advantages conferred on the passive defenses. If all the means tending to the masking of shore defenses are utilized, we now have the assurance in using smokeless powder that shore guns can remain absolutely invisible from ships. General Sir Evelyn Wood in reporting on experiments made to test this fact says that after a battery had been firing a long time rapidly with cordite, that it was absolutely impossible to locate it at a distance of a mile and a half.

In placing batteries, then, the engineer is governed by certain conditions; they should be dispersed; the fire intended for one battery should not reach another; the guns in each battery should be so placed that the chances of a raking hit are minimized. These results are accomplished from a knowledge of what positions ships must take, and protection is further offered by traverses which equally prevent injury to one gun involving others. It is not deemed advisable or necessary to give seacoast batteries much passive protection from land attempts. There is a danger in closing such works to the rear in confining the explosive effect of shells falling within them to the locality where they produce the most damage, and they should be allowed free passage to the rear.

The defenses against land attack upon isolated batteries are best in the hands of infantry and light artillery armed with the magazine rifle and machine guns.

When engineers have the problem of protecting or fortifying a particular harbor before them, they have first to consider the probable magnitude of any attack that may be made upon it. Certain places are of sufficient strategic or even intrinsic importance to warrant perhaps the assumption that a large portion of the maritime resources of any probable or possible enemy may

be liable to be brought against it. Again there are places where it is equally certain that the enemy would not send a man to do a boy's work. Having determined such matters satisfactorily, it becomes necessary from a study of foreign navies and the water front of approach, to estimate as accurately as may be, the gun strength that may be used in the siege by a fleet, as a basis of calculation of the gun strength to be supplied to the place. At this point the widest divergencies of opinion may be found amongst engineers, and such must of necessity be the case.

From the intelligent study of past engagements in which fleets and fortifications have figured, the estimates have varied in different times according as the estimation in which fortifications have been held. At one period it was generally thought in this country that the defense is equal to the attack in the ratio of one to two, though it has been contended that it should be one to one. It was a common saying a hundred years ago along the shores of France, that one gun ashore was equal to three or four afloat. Beyond this, every ratio has been advocated up to one to fifty. Of course the natural features of harbors conducing to greater or less ease of defense have an important bearing. Another point of divergence is related to the same question but has to do with the calibers of guns on shore. In this country the practice, so far as known, on which our system is based, is that the guns should be the equal in calibre and power to those to be brought against them, or of power sufficient to master the thickest armor. Such is the general practice, but it is ably and intelligently argued on the other side that there is no need to follow such a system, any more than it is desirable to reproduce on shore the features of battleships in costly armor-faced batteries.

A distinguished American engineer not long since in making a close analysis of coast defenses, in their relation to expense, examined into the best means of investing a limited sum of money for the defense of one position. He rightly concluded that for a million dollars the better investment would be in submarine mines, operating casemates, cable shafts nd galleries, mortar batteries, lifts, and disappearing gun batteries, than in a turret for two 110 ton guns; and that it would be better than the turret and the two guns, to provide the equivalent which would be represented by thirty-two 12″ rifled mortars, six 12″

rifles, one mounted on a lift and five on disappearing carriages behind substantial earth parapets, and an effective system of mines, with casemates, cable galleries, etc.

In pursuance of our present scheme of fortifications, it would seem that following the expressed intention of navies not to mount any longer the heaviest ordnance, the question of the heaviest guns in this country has for the present lapsed, it being understood that no gun heavier than 12″ is contemplated. On the same subject one of the ablest of English writers gives as his opinion that: " A couple of well placed earthn barbette batteries containing a dozen rapid-fire guns might do more for the defense of any given position than the most approved casemated battery or turret mounting 80 or 100 ton guns."

[*To be continued in the next number.*]

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ORDNANCE AND ARMOR.

(A paper read at the War College in August, 1900.)

By PROFESSOR PHILIP R. ALGER, U. S. Navy.

Ordnance may be conveniently discussed under the four headings of The Gun, Gun Mountings, Powder, Projectiles.

No change has been made for many years in either the material or the general method of manufacture of guns. Larger steel forgings, of higher characteristics, and at lower prices are to be had today than were available a few years ago, but the guns of the Atlanta, Boston and Chicago, designed in 1881 and 1883, do not differ in any essential from those designed two years ago for ships whose construction has just begun.

Progress, as far as the gun itself is concerned, has been in the direction of greater power and greater rapidity of fire. The first of these has come from better powder and larger powder charges, and the second, primarily, from gradual improvements in the details of breech mechanisms—neither has resulted from any radical change of system.

Considering power first. Until two years ago, all our guns were designed with chambers of a size to take a brown powder charge of half the projectile weight, which gave from 2,000 to 2,150 f. s. muzzle velocity, according to the length of the bore, while the use of smokeless powder in the same guns added some 300 f. s. to the velocity, without increase of chamber pressure. It was not inability to increase the power of our guns that held them stationary for so many years. In a paper read here four years ago I stated that the power of any caliber could be indefinitely increased at the cost of the extra weight involved in having a larger chamber to hold a larger powder charge, and

a longer bore to consume it in. It was the disadvantage of the greater weight and cost of the powder charge that made it seem inexpedient to advance in this direction. But the successful development of smokeless powders largely obviated this objection, and an increase of power having been decided on, it was wisely determined to take a long step at once instead of trying to advance by slow degress. The new guns, therefore, were all designed to give 3,000 f. s. muzzle velocity, their smokeless powder charges being of nearly as great weight as were the brown powder charges formerly used by the same calibers; and they have actually given this, and even higher velocities, on the Proving Ground. To appreciate what this means, it must be realized that the muzzle energy of the new guns is two and a quarter times what the old designs of the same caliber developed with brown powder, and from sixty to seventy per cent greater than that given by the old designs when they used smokeless powder.

The new 12-inch gun is as long as the old 13-inch and its muzzle energy is greater, but, with its mounting, it weighs nineteen tons less and its ammunition weighs about 400 lbs. less per round. Supposing an allowance of 100 rounds per gun, we have greater armor penetration and a much flatter trajectory on thirty-seven tons less weight.

The question, then, naturally arises, why not continue further in the same direction? Having replaced a 13-inch gun by a higher powered 12-inch, why not replace the latter by a still higher powered 10-inch gun? We can make a 10-inch gun of as great energy as the latest 12-inch and yet save weight on the total installation. It would require 4,000 f. s. muzzle velocity, but this can be attained, I have no doubt. In fact, we have seen exactly this same line of advance followed in the development of the modern small arm. From the days when the caliber was nearly an inch, till the present time when 6.5 mm. (about ¼ inch) is generally held to be the most advantageous size, progress has consisted in a constant decrease of caliber without any corresponding decrease of chamber volume, the result being a gradual increase of muzzle velocity. The bullet of the 45-caliber weighs four times that of the 6 mm. rifle, but the cartridge case of the latter is almost as large as that of the former, and muzzle velocity has been increased from 1,200 to nearly 2,600 f. s.

There is an important difference between the two cases, however. Flatness of trajectory is equally of value in fighting between ships at sea and between men on shore, on account of the resulting increased danger space. Reduction of weight per round of ammunition, while most important to the soldier, is still of great advantage on the war vessel. But the one disadvantage of the small caliber, its less destructive effect, tells against it in naval warfare far more than in land fighting. Man is so highly organized an animal that, as a rule, any wound will put him out of action, but a ship may be pierced through and through without having either its offensive or defensive powers materially reduced. In a battle, the more men wounded, however slightly, the sooner is victory won; when a great ship is the object of attack, it is most important that each blow successfully landed shall produce a serious destructive effect. The widespread effects of the large caliber shell are needed to produce decisive results. If rapidity of fire were inversely proportional to weight of projectile, the process of reducing caliber could be advantageously extended much further than it now can be, but there is practically little difference between the rates of fire of the 10, 12, and 13-inch calibers, and while a great deal of weight would be saved by substituting a 10-inch gun of equal power for a 13-inch, the decrease of projectile weight from 1,100 to 500 lbs. would not be compensated for by any material increase in the rate of fire, and the slight increase in the percentage of hits resulting from the flatter trajectory of the smaller caliber would by no means make up for the vastly greater destructive effect of the larger shell. In the small-arm and machine-gun field, where it is really better to wound a man than to kill him, and where any man who is hit, whether by a small or by a large bullet, is almost certainly put out of action for the time being, the greater percentage of hits due to the flatter trajectory is important, and the increase in the number of rounds carried by the soldier, due to their less weight, is a decisive reason in favor of the smallest practicable caliber. In the field of heavy naval guns, the destructive effect of each projectile become a matter of great importance, and this consideration puts a limit to advantageous reduction in caliber. For a long time I was an advocate of retaining the 13-inch gun for our battleships. I am now inclined to think that the reduction in caliber to 12-inch is, on

the whole, advantageous, but I think it would be going entirely too far to make the 10-inch the largest naval gun.

Considering next "rapidity of fire." As already stated, so far as the gun itself is concerned, the increased rate of fire from the more recent heavy guns has been brought about entirely by improvements in breech mechanisms. Of course, smokeless powder is the greatest of all the factors that tend to rapid fire under service conditions, and next to this comes skill in rapid pointing, but I refer rather to rapidity of unaimed fire, which depends entirely upon the "loading interval," or the time from one discharge till the gun is again loaded and primed. The automatic principle, whereby a portion of the energy of each fire is used to reload and fire again, has been extended from the machine-gun caliber to the 6 pdr., and even to the 14 pdr., but the 1 pdr., with its 250 shots a minute, seems to be the limit of its really advantageous employment. This system results in a stream of projectiles that can be directed much as is water from a hose, but as the weight and cost of ammunition increase with increase of caliber, it becomes more and more important to make each separate shot an aimed one. Moreover, as the weight of the ammunition increases, automatic loading becomes too violent for safety and efficiency.

The semi-automatic system, in which the force of each discharge opens the breech and at the same time compresses a spring which, when set free by the act of loading the next cartridge, again closes the breech, has a wider range of usefulness. Applied to the 6 pdr., this system has given a rate of fire of upwards of fifty shots a minute, and although of less value as caliber increases, I predict that its use will be extended to the largest guns. The time required to open and then close the breech of a heavy gun fitted with our usual breech mechanism varies from nine or ten seconds for the 8-inch, to upwards of fifteen seconds for the 13-inch, and a saving of this time—possible by utilizing the counter-recoil to open and also to store up power for closing the breech—is of considerable importance.

One of the greatest aids to rapid loading is fixed ammunition, whereby projectile and powder charge are loaded in one motion and no subsequent priming is required; but this becomes impracticable when the weight of a complete round is too great to be readily handled by a single man. This fact limits the advan-

tageous use of metallic cartridge cases to the 5-inch caliber, whose fixed ammunition weighs nearly 100 lbs.

With the 6-inch, and still more with the higher calibers, separate loadings of projectile and powder charge are necessary, and the great weight of the cartridge case makes its use undesirable. It was a mistake to adopt a brass cartridge case for the 6-inch R. F. gun, and with the new 6-inch and even with the new high power 5-inch guns we are going back to the old fashioned cartridge bag. The brass cartridge case had two advantages, even where fixed ammunition could not be used: 1st It was an efficient gas check separate from the breech mechanism itself, and so the latter required no great force to open it and could be rapidly manipulated. 2nd. It carried its own primer and so saved the time required for extracting the fired primer and inserting a new one at every round. On the other hand, the 6-inch case weighed thirty pounds by itself and the extra weight had to be put into and withdrawn from the chamber at each round. A slight improvement in the gas check has now enabled us to use what are called rapid-fire breech mechanisms, which open or close by a single sweep of the hand, on 6-inch, and even larger guns of ordinary type. Moreover, a firing mechanism has been devised that automatically ejects the fired primer as the breech is opened, and that also permits repriming while the breech is open, without any resulting danger of a premature explosion. Thus we are now able, by suppressing the brass cartridge case, not only to make a great saving in the weight and cost of the 6-inch ammunition, but at the same time to slightly increase its rate of fire.

We have never attempted to use a cartridge case with calibers above the 6-inch; nevertheless, the reduction of the loading interval brought about by improvements in their breech mechanisms has been still more considerable than with the 6-inch gun.

With the old 8-inch, at least nine or ten seconds per round were required for opening and closing the breech, and the operation of priming also increased the loading interval; with the latest 8-inch breech mechanism, opening and closing, are much more rapid, and the priming is done while the shell and charge are being located. The result is that a rate of unaimed fire of nearly six rounds a minute has been attained with an 8-inch gun at the Proving ground. When it comes to aimed fire under ser-

vice conditions, of course, such rapidity is out of the question. One well-aimed round a minute would be very good for the 8-inch gun of present service type, and I should say that equal skill might give pretty nearly two rounds a minute with the new gun and also with the most improved electric training gear. Perhaps it would be safer, however, to count on only a round every forty-five seconds.

The latest guns of caliber above the 8-inch will also have a less loading interval than the present ones, due to an important improvement in breech mechanisms, which has been applied to all calibers from the 4-inch up, but which has greater advantages as the caliber increases. I refer to the use of a breech plug that has more than half its surface threaded, thus allowing a decrease in length of screw box, with notable attendant advantages. The method of doing this was devised by Mr. Axel Welin and was acquired by the Bureau of Ordnance from Vickers Sons and Maxim, who controlled the invention. Of course, if three-quarters of the surface of a plug can be threaded instead of one-half, the length can be reduced one-third without loss of strength. The result is that some six or seven inches have been removed from the breech end of the 12-inch gun, which means, first, a saving in weight and cost of gun; secondly, a lighter and more easily manipulated breech block; thirdly, a more direct lead of the ammunition hoists from loading-room to breech, and less space to lead through; and fourthly, a less diameter of turret, with saving of weight and cost of armor. The reduction in the "loading interval," due to this shortening of the screw box, is considerable, and to make any important further gain we must apparently adopt the automatic principle, to the extent of using the force of the discharge to open and afterwards close the breech.

Considerations of weight of breech-block and of space in the turrets will probably prevent the use of single motion breech closures for the larger calibers, and some modification of the automatic system must be relied upon to increase the rate of fire of the 10-inch and 12-inch guns. Furthermore, it must be remembered that the automatic operation of the breech mechanism will result in other important advantages besides the reduction of the loading interval; it will reduce the number of men required for working the guns and it furnishes a perfect

protection against the dangers of hang fires, since the breech cannot open until the powder charge has exploded and caused the gun to recoil.

To sum up, then, in regard to the gun, we have in the last few years increased the power of our guns so that we can now use a 12-inch instead of a 13-inch as the largest gun of our battleships, and we have at the same time increased the danger space of all our guns, so that we are less dependent upon knowledge of distance for accurate gunfire than ever before. We have also increased rapidity of fire by minimizing the loading interval, the gain being great for small guns, and though as yet small for the larger ones, sure of being made greater by the extension to them of the same principles as have been successfully applied to the small guns. It is still true, however, as I said four years ago, that "rapidity of fire with heavy guns depends far more upon the skill to be acquired by constant practice than it does upon further perfection of mechanical details." Nothing but constant practice can give that perfect command of the loading and pointing mechanism, which, far more than anything else, will give rapid and accurate fire.

Coming next to the general subject of gun mountings. The most important recent development in this field has been the successful use of electricity for manipulating the heavy guns. The great advantages of this form of power for use on shipboard are well known—the doing away with the heat and danger of steam pipes, the ease and simplicity of the means of transmission by wire, and the facility of control would long ago have insured the exclusive use of electric power for working heavy guns, had it not been for a general feeling that it was unreliable. Frequent failures of electrical appliances on board ship, and the usual difficulty of quickly locating such failures made people hesitate to rely entirely for electric power for so important a thing as the operation of the main battery of a battleship. But better apparatus, resulting from vastly greater experience on the part of the manufacturers of electrical appliances, better installation, resulting from our own greater experience, and above all, greater knowledge and practical experience on the part of both officers and men, have removed all the serious disadvantages, and in future installation of heavy guns we shall realize the great advantages that flow from the use of electric power. More

accurate, as well as more rapid pointing will be the result, while the danger of hostile fire putting a turret out of action will be greatly lessened. Hand elevation, rendered possible by the use of the gun slide balanced on knife edges, limits the necessity of power, and the use of wires instead of pipes for transmitting the required power, reduces the risk of its being cut off, besides making it much easier to repair a break, if one occurs.

It has taken many years, but at last we have reached the point of ceasing altogether to manufacture gun powder, except for shell charges and saluting, and while large quantities of brown powder are still on hand and must be expended in target practice, all new ships have a full outfit of smokeless powder, and the old ships are gradually being supplied with it. It would be difficult to over-state the importance of this change. Independent of its great advantages from a tactical standpoint, it has added immensely to the power of our guns; it has simplified the loading operations by the absence of the solid residue which resulted from the combustion of gun powder; and it enables us for the first time to really attain under service conditions a rate of fire approaching that which has been reached on the Proving Ground.

Our smokeless powder is a pure colloid produced by the action of ether and alcohol on soluble gun cotton. The Navy owes this smokeless powder to Lt. Bernadou, who with the full cooperation of Capt. Converse, then in command of the Torpedo Station, developed its manufacture from beginning to end. He succeeded in making a gun cotton which we call pyrocellulose, which while containing about 12.4 per cent of nitrogen, is yet wholly soluble, and, when acted upon by ether and alcohol, becomes a very tough and homogeneous colloid which can be relied upon to burn progressively even under very great pressure. One of the troubles with brown powder is that however dense its grain are made, they crumble under high pressure, and instead of burning from the surface and so developing moderate and safe pressures, sometimes go off all at once, as it were, producing sudden and dangerous rises in pressure. To this same action I have always attributed the frequent excessive pressures resulting in several cases in destruction of guns and loss of life to the gun servants, which smokeless powders containing nitroglycerine have given. Excepting where insuffi-

cient experience and care in the manufacture have resulted in the presence of considerable insoluble gun cotton, mixed with the pyrocellulose, we have never to my knowledge, had a case of sudden and excessive rise in pressure, and we have never had an accident, at the Proving Ground, with our smokeless powder. The principle of using a homogeneous colloid, containing no foreign substances whatever, has certainly been justified by results thus far.

As regards projectiles, I can see but one important step in advance that has been taken in this field within the past few years, and that is the adoption of the cap to increase the effectiveness of armor piercing shell against hard faced armor.

The true nature of this valuable improvement is little known and the common explanation of its action is, in my opinion, without any validity or even rational foundation. The vague statement that the cap " supports " the point of the shell explains nothing, and to say that the soft metal of the cap lubricates the shell point and so helps it through the armor seems to me rather absurd. The real explanation of the action of the cap is closely connected with that of the great resistance of the hard face of modern armor. The hard face, being of great strength and of the highest elasticity, prevents the localization of the effect of an impact upon any part of it. Instead of yielding only at the point struck, a large surrounding area comes into play, and, yielding elastically, offers a great and increasing resistance to the impinging object. Now this elastic resistance, much greater than any force produced by impact upon a homogeneous steel plate, is more than the projectile can withstand; the shell yields at its weakest part, and the crushing action, once begun, extends till the whole projectile is smashed into fragments. When the cap is used, the bending back, almost to the point of rupture, of the face of the plate, takes place while the projectile is piercing its cap; the cap is destroyed, but the shell is saved, and when, still intact, it reaches the surface of the armor, it finds that surface on the verge of yielding, and perhaps actually broken through already, just at the point of impact: the projectile is able to penetrate the already weakened hard face and the softer body of the armor is comparatively easy to perforate. There is nothing in this action, as far as its effectiveness is concerned, which at all resembles the action of a buffer. If the cap were a mere

buffer, acting to slow down the shell and so lessen the shock of its impact, we could attain the same result more simply by reducing the initial velocity, but actually a lower velocity of impact seems to add to the certainty of the shell being shattered. One curious fact tends strongly to confirm my theory of the cap's action. If a capped shell be fired against a hard faced plate with very low velocity it is smashed just exactly as an uncapped shell would be. This is because the force of the impact is insufficient to materially weaken the hard face while the cap is being destroyed and so the shell point finds it, not on the verge of yielding, but as strong and resisting as ever. Were the action of the cap a lubricating one, which in itself is inconceivable to me, the fact just set forth would want an explanation.

The manufacture of armor was revolutionized by the discovery that it was practicable to face hardened thick steel plates; the invention of the shell cap has come near to restoring the former relations of armor and projectile. To say that the cap has added 20 per cent to the efficiency of the armor piercing shell is to inadequately represent its value, it has done more than this, it has brought back the old conditions, an increase of thickness of plate can again be met by a merely corresponding increase of striking velocity; whereas with uncapped shell against hard faced armor, a slight increase of thickness of the latter had to be met either by an increase of caliber or by a very great increase of velocity. In my opinion, the cap should be used on all shell, not on armor piercers alone. We have adopted, wisely, I think, the plan of making our common, or explosive shell, of forged steel, having some armor piercing qualities, sacrificing size of explosive charge for the purpose of extending their field of effectiveness to cover the thinly armored portions of an enemy. Such shell would certainly be made still more efficient, if capped, and the cost of capping is so small as to fully warrant its being made universal for shell of 4-inch caliber and above.

We have not yet put loaded A. P. shell into service, but I hope we soon will. It seems to me to be very desirable to use bursting charges of some substance, such as picric acid, jovite, or fined grained smokeless powder, which, by the action of the ordinary percussion fuse, will burst the armor piercing shell. This action is not detonation, but ignition by flame from the

fuse, resulting in a sufficiently slow development of pressure to allow the shell to pass through any armor it can overcome before bursting.

Several years ago we fired at the Proving Ground, a 10-inch A. P. shell loaded with jovite, through a 14-inch Harveyized plate, and burst it behind the plate. The certainty of the shell, if it gets through armor, being broken into pieces, and not remaining whole, would be worth a good deal, even if the explosion itself was of little violence.

As far as high-explosive shell are concerned, we have none in the service, and I see little to warrant their use. To get good effect a high explosive shell requires a fulminate detonator to be associated with it; such shell are vastly more dangerous to use; and, in my opinion, but little, if at all, more effective than powder loaded shell. For use with high angle fire from shore batteries, the high explosive shell of large capacity may serve a useful purpose, since its sphere of action is considerably increased by the torpedo effect of an under-water burst, but in sea fighting, the flat trajectory needful for any reasonable chance of hitting renders such an effect impossible. Recent experience in the Soudan and in South Africa has certainly not tended to uphold the commonly accepted views of the terribly destructive effects of high explosive shell when fired from field and siege guns, and, personally, I believe the reports of the effect of lyddite and melanite shell in English and French tests have been enormously exaggerated. Such shell have not yet been used in actual naval fighting, but I have no confidence in their effectiveness. Even thin armor will cause the detonator to explode the shell harmlessly outside, and a burst inside, while producing a somewhat greater explosive shock and more fragments of the shell, will be less likely to cause fire, and I think, do but little more harm than would the same shell if burst by gunpowder. A design of canister for the 4, 5 and 6-inch guns was adopted some two years ago, and I suppose these projectiles are now being issued to service. While primarily for use against exposed men at short range, they may prove of value in defense against torpedo boat attack, where the chance of a hit from a single projectile from any large gun is very small.

We have, then, four classes of projectiles, A. P. shell for use against armor: common shell for use against unarmored, or very

thinly armored parts: shrapnel for use against exposed bodies of men at a distance: and canister for use against exposed bodies of men at close range.

Which of the first two classes would better be used in a naval action, of course, depends upon the type of our opponents. If unarmored common shell alone should be used, with the proviso, that what we generally called the A. P. shell of the minor caliber R. F. guns are really only steel common shell and should be used even against torpedo boats as the small cast iron shell breaks up on very thin plating. If armored, the question what kind of shell to use becomes more difficult. Considering that either the 10, 12 or 13-inch forged steel common shell will carry their bursting charges through at least 6 inches of hard faced armor, it is seen that by the use of such shell, instead of A. P. shell, we add greatly to the destructive effect of a hit anywhere except on the very small area which is covered by thick armor, while, on the other hand, we reduce to zero the effect of a hit on this thick armor. This seems to me to indicate the desirability of using both classes of shell from the heaviest guns, either firing them alternately, or using the common shell in the earlier part of the action, and later on, when range is shorter, and the enemy's secondary battery has presumably been wholly or partly disabled, using A. P. shell. As for the 4, 5, or 6-inch guns, if we use common shell from them, we restrict their area of destructive effect to the wholly unarmored, and consequently unimportant parts of the enemy, and this seems to me to indicate A. P. shell as best suited to those calibers. If we have 8-inch guns, the thickness of the secondary armor of our opponent must be known in order to decide whether A. P. or common shell are best, if this armor be not over 4 inches thick, common shell will probably get through it and should be used, otherwise A. P. shell. This, however, is all on the supposition that the enemy is of comparatively recent construction, having the distribution of hard faced armor now usual. If of old style, having little or no secondary battery armor, common shell from all but the heaviest guns should be the rule, and, in fact, the guiding principle in all cases should be to use whatever will be most effective against the personnel and the guns of our opponent.

As to a naval attack on shore fortifications I assume that such an attack will only be made under circumstances which

render it essential to destroy, or at least to silence them for a period, and in my opinion there is but one way to do this. That is to put the broadsides of the ships as close as possible to the forts, and from a stationary position, to overwhelm them by superior weight of fire. In a purely naval action, the better your gunnery, the more advantageous it is to you to keep at long range: as distance decreases, superiority depends more and more on number and size of guns, and less and less on marksmanship. (I assume, of course, an equal morale on either side). But the stationary platform, the range finding facilities, and other conditions which obtain in fortifications, are the equivalent of an enormous superiority in marksmanship, and the only way to balance this, is to get so close that every shot from your own guns will hit. If shore guns are mounted so high above the water that they cannot be effectively reached by fire from a ship at short range, then it is practically impossible to destroy them, and nearly as impossible to render them temporarily innocuous. If, however, they can be reached by naval gunfire from short range, then, it seems to me, the quickest, surest, and on the whole the safest way of attacking them, is by going as close as possible, and getting the most out of the ships superior weight of fire. Within 1000 yards, within 500 yards if possible, using common shell from the heavy guns, and shrapnel or canister from some at least of the medium guns, the machine guns in the tops within effective range, it seems to me that a single battleship would more effectually dispose of any given shore battery than would a squadron steaming back and forth at 4,000 or 5,000 yards range. Even if the fort be too high to be commanded by any guns afloat, the breaching of its parapets, necessary for its destruction, can only be accomplished from a position near enough to insure every heavy shell striking, while at the same time the small guns will thus be most effective in keeping down the hostile gunfire. It is in breaching fortifications, if anywhere, that high explosive shell would be of great use, their mining power being two or three times that of black powder shell. In this connection note that there will be great advantage, in any manoeuvering within range of hostile forts, to use as far as possible the method I advocated yesterday for ship actions, *i. e.*, to steer a course such that the bearing of the fort is constant.

The latest armor, said to have 20 per cent more resistance than Harveyed armor, is made by the Krupp process, which, though kept secret, may at least be said to be merely an improvement on the Harvey process. Instead of making the plate of steel containing 3 per cent of nickel, an alloy containing not only nickel, but also a small percentage of chrome, and perhaps also tungsten, is used; the face of the plate is carbonized by some process which is the equivalent of cementation, and finally the usual cold water spray is used to chill the surface. The result is a deeper chill than is ever attained by the Harvey process, and a consequent greater surface resistance, tending to break up shell which strike it. Moreover, there is less cracking under shock or perforation. The improvement, however, is not very great. The so-called increase of 20 per cent in resistance, means resistance to uncapped shell; when capped shell are used the increased resistance to perforation is little or nothing.

As regards the use of armor and its best distribution, it should be recognized that naval victories are far more likely to result from the destruction and demoralization of an opponent's personnel than from actual injury to his ships. The Chinese battleships retreated from the battle of the Yaloo utterly defeated, yet neither their stability, their machinery, nor their offensive powers had been seriously affected; at Manila Bay, and again at Santiago our gunfire did not injure the Spanish ships so much as it did their crews, and except for the fires which an inefficient and demoralized personnel could not control, the material would have remained practically uninjured. Armor, in fact, was devised as a means of protecting the personnel from the effects of shell fire, and in so far as this end has been lost sight of, and attention directed mainly to the protection of the water line and motive power, an error has been made. The present tendency to thin water line armor and devote the greater part of available weight to protecting the guns and their crews, seems to me to be a wise return to first principles. It is useless to endeavor to secure complete protection for anything; the heaviest guns of a battleship will drive their armor piercing shell through any armor yet made or ever likely to be made if they hit nearly normal. The most that can be asked of armor is that it shall protect whatever is behind it from anything but the direct hit of a large caliber projectile. The Maine class have a belt tapering from 11

to 7½ inches, a great change from the belt of the Indiana, the 14-inch belt of the Iowa, and the 16½ to 9½-inch belts of the Alabama class. Yet I think even a further reduction, if made for the purpose of adding to gun protection might be defended. What is wanted is to entirely exclude any explosive shell of sufficient power to pierce the protective deck with its fragments; to keep out all projectiles except those of the largest caliber striking nearly normal; and to sufficiently retard the latter to prevent them from getting through the protective deck. The chance of hitting the belt is very small; only about ⅙ as great as that of hitting a 12-inch emplacement (turret and barbette), and the chance of a normal hit on the belt is almost nil. At Santiago there were but three hits on the belts of the Spanish ships, out of 9,500 shot fired, and in the Belleisle experiment, where the vertical errors were much less than they would be in action, and where double the usual width of belt was exposed owing to light draft, there were, so far as I have been able to learn, only about 15 hits on the belt out of over 1300 shot fired. Consequently, I think the Maine's 9½-inch at the water line, with water excluding material behind it, and with a protective deck 4 inches thick on the slope, furnishes ample protection. The following are the approximate armor weights of the Maine class:

Belt	785 tons
12-inch gun protection	845
Casemate	795
Conning and signal towers	90
*Protective Deck	1039
	3554

From which it will be seen that after more than half the available weight has been devoted to the protection of buoyancy, stability, and motive power, the remainder is approximately halved between the 4 12-inch and the 16 6-inch guns.

As regards the two heavy guns' emplacements, the 12-inch armor seems to me to afford reasonable protection except in

* This is total weight of deck. The armor plating on the deck only weighs about 550 tons.

one respect. I think the port plates of the turrets, which are always towards the enemy, and which are weakened by the port holes, need further strengthening. It is customary to make these plates slightly thicker than the others in the turret, and in the case of the Maine class, while the rest of the turret armor is 11 inches the port plate is 12 inches thick. Moreover, in our present excellent turret design, the port plate is sloping so that the angle of impact cannot be much less than 35° in any case. Still, considering that the port of the turret must always be exposed to direct fire, while the rest can only be hit from the unengaged side, and considering further that but little extra weight would be needed, I cannot but think that the port plates should be made much thicker than is the present practice. Especially should this be done in the case of the 8-inch turrets on ships carrying them. The plans under consideration for the Pennsylvania class contemplate about the same belt and 12-inch turret armor, and also provide 6-inch turret armor with 6½-inch port plates for the 8-inch guns. It would add practically nothing to their total armor weight, and would, in my opinion, greatly increase their defensive power if the 8-inch turret port plates were made 10½ inches thick instead of 6½ inches.

As regards the 795 tons of armor given to the protection of the 6-inch guns of the Maine class, it is to be noted that about half of this is used to cover the space between the top of the belt and the deck upon which the 6-inch guns are mounted. This is to prevent the alleged great destructive effect upon the deck of high explosive shell if allowed to freely enter the space beneath it. It seems to me that some better arrangement could be made than to cover with armor an immense space which contains practically nothing of importance. The smokestacks, 6-inch ammunition hoists and anything else worth protecting could be directly armored for a small fraction of the weight now used in covering the whole side, and I would advocate an entirely different arrangement. I have become convinced of the necessity of more complete isolation for guns than we have thus far ever given them. The effect of a single heavy shell bursting in the casemate, might well be to put out of action every gun it contains. I used to think that traverses were sufficient protection against this, and that the advantages of a comparatively open battery deck with free communication from gun to gun were

too great to be given up. Smokeless powder renders central battery control much less important than formerly, individual firing must practically be used under all circumstances of action and, furthermore, we have had recent practical lessons as to the widespread destruction that may be caused by the explosion of one large shell. If all the guns are in pairs in turrets, each with enough armor to give it safety unless directly hit by a heavy gun, then no shell can do more than put one pair of guns out of action, and, what I think is of great importance, not only is material damage localized, but so equally is moral effect—each turret will go on fighting, independent of and even quite ignorant of the destruction which may have visited the others. In the Pennsylvania class it is now proposed to expend 1100 tons of armor in covering a space about 250 feet long by 15 feet high in order to give 12 6-inch guns 6-inch armor protection. The turret system would give much better protection on much less weight, and at the same time greatly reduce the area which must be hit in order to disable a gun. One objection will be the fear that rapidity of fire will be reduced by mounting the guns in pairs in turrets instead of in separate broadside ports, but with the facility of train given by the use of electric motors, I do not think that there will be any marked difference in this respect. It must be remembered that in future the 6-inch brass cartridge case will be dispensed with, so that there will be no more trouble in disposing of fired cases, a difficulty that might be serious in a turret. The shell could be stored, at least to a considerable number, in the turret itself, and there would be at least as rapid a supply of ammunition as if the guns were mounted on an open deck. If, however, the turret system is not used for the 6-inch guns, then certainly these guns should be better protected than they have been hitherto from the effects of a large shell bursting within the battery; heavy transverse bulkheads between the guns, will furnish very important protection, but longitudinal bulkheads behind the guns should also be used, so as to have each gun in a compartment by itself. More certain destruction of the entire contents of any department entered by a heavy shell will result, but so also will such destruction, with accompanying flames, smoke fumes, and the demoralization effect of the sight of killed and wounded, be equally localized. There is this to be said, casemate armor, like belt armor, can only receive a

normal impact when the ship is at exactly right angles to the line of fire of an enemy, while turret armor is always exposed to the possibility of a normal hit; but, on the other hand, the use of turrets instead of a casemate, greatly reduces the target area. With the casemate what is most to be feared is a raking fire, a heavy shell entering and ranging force and aft, and this is one more objection to the end on position to an enemy.

The foregoing discussion naturally leads to the question of the caliber and arrangement of guns best suited to a battleship. There is almost universal agreement as to the great advantages of two pairs of heavy guns in turrets on the center line, one forward and one aft, but what the remainder of the battery would better be is much more doubtful. Were it practicable to mount a third pair of heavy guns on the centre line, I would greatly prefer doing so and sacrificing all other guns excepting small R. F. guns for use against torpedo boat attack. Assuming, however, that this cannot well be done, the question seems to narrow itself to this,—shall we have 6-inch guns alone, 6-inch and 8-inch guns, or shall we adopt an intermediate caliber, say the 7-inch?

In modern battleship design weight of battery counts for little as compared with space for good gun positions. If the 5-inch R. F. gun could pierce any secondary armor, we still could not afford to have 5-inch guns only as a secondary battery, because good positions cannot be found for enough of them. We would still use 6-inch guns because we can mount as many 6-inch as 5-inch, and while an equal weight of 6-inch guns would give less, and an equal number of 6-inch guns would give much the greater volume of effective fire. Now this argument seems to lead logically to the use of a still larger caliber, say the 7-inch, instead of the 6-inch, but the objection to this is that when you go beyond the 100 pound 6-inch shell two men are required to handle the heavier projectile and at once rapidity of fire is greatly reduced. Granting that the 6-inch gun is effective against all secondary armor, I think it must be admitted that this caliber is the proper one for the secondary battery of a battle ship.

The question, then, is, shall we have any other guns, of caliber between the 6-inch and the 12-inch, and to this I answer yes for the reason that there is an ideal gun position on top of the 12-inch turrets, and since we can only mount one pair of

guns in each of these positions, we must chose the most effective ones. 6-inch guns equal in weight to 4 8-inch may give a greater volume of effective fire, but if forced to chose between 4 6-inch and 4 8-inch, the latter seems to me much the preferable. While it is true the weight of fire per minute of a 6-inch may equal that of an 8-inch gun, the much greater certainty of the 8-inch piercing the armor of an opponent adds enormously to its value.

To sum up then, I would advocate, 2 12-inch turrets with 8-inch turrets on them, and a 6-inch R. F. battery between the heavy gun positions. I should prefer the 6-inch to be in turrets, three pairs on each side on the main deck, and a pair on each side on the upper deck, but if in a casemate, I think that each gun should be completely enclosed. As to the superimposed turrets, their advantages are so great as to demand their use even should the 8-inch caliber be abandoned. 6-inch in turrets must then be placed on the 12-inch.

Every one must recognize the great tactical advantages of putting an 8-inch turret on the middle line instead of on the broadside, and the only practicable way of doing this is by the use of the superimposed turret. There have never been but two objections, worthy of consideration, to this plan. The first, that there would be interference between the two pairs of guns, the loading and firing of one pair disturbing that of the other pair, seems to have been disposed of by the tests of the Kearsarge. The second, that there is too much concentrative of the battery, too many of your eggs are put in one basket, is still open to argument.

That an 8-inch turret on top of a 12-inch turret is very much safer than one standing by itself seems to me unquestionable; the turrets themselves have exactly the same chance of being hit, but the loading and training apparatus of one is protected by the thick armor of the 12-inch turret and barbette, while that of the other has only the protection of its own thin barbette armor. If, moreover, the weight of the 8-inch barbette, which is saved by the superimposed turret plan, be used to double the thickness of the 8-inch turret armor, then evidently, on equal total weight we have much greater safety from injury as well as the double offensive power given by the middle line position. The only answer to this is the statement that a shell which enters the

superimposed 8-inch turret and puts its guns out of action, may also disable the 12-inch guns, but, in my opinion, this is a very improbable occcurrence; a burst in the upper turret may drive some fragments down through the loading openings and do some harm in the lower turret, but no serious harm, the heavy plating between the two turrets will prevent that. The only weakness of the double turret is the fact that an injury to the 12-inch training gear will affect a pair of 8-inch as well as a pair of 12-inch guns, to balance which we have the fact that there is only one barbette to be hit, instead of two, and that one having thick armor. Therefore, certainly, the advantages are altogether on the side of the superimposed turret, and I think that few, if any, of its opponents, but would prefer this to the broadside position if only two 8-inch turrets were in question. Whatever strength their argument has lies in the contention that four turrets, two on each broadside, are better than two superimposed turrets. Now, personally, I deny this. I contend that the multiplication of gun positions, with an equal increase of the vulnerable area, is of little or no value, unless there be an accompanying increase in volume of fire. The two superimposed 8-inch turrets give the same weight of fire against a single opponent as the four broadside turrets, and the chance of being engaged on both sides at once is too remote for serious consideration. At the same time the four broadside turrets offer twice the target area of the two superimposed turrets. But without regard to this, if it once be admitted that two superimposed turrets are better than two turrets, one on each broadside, then, in case four are proposed, why not have two of these superimposed, and at least gain that much? I cannot but think that the continued opposition to the superimposed turrets is due to an excess of that valuable quality, conservatism. Certainly, to delay decision for the sake of a practical demonstration of the advantages of the system, is useless, for no such demonstration is possible. Actual tests can, and I believe have, shown that there is no interference of one turret with the other tending to slow its fire or reduce its accuracy, but what more they are expected to show, I cannot imagine. No practical tests, not even the test of actual battle, can do anything towards settling such a question as this. The victory of one battleship over another could hardly be claimed to be the result of a superior arrangement of battery,

too many other possible causes may have existed to allow such a conclusion to be undisputed. After all, the lessons of any future naval combat are only the conditions drawn by reasoning from certain facts or alleged facts and are just as open to dispute, just as likely to be denied, as are the conclusions drawn from the vast storehouse of past experiences.

Take the question of the use of shields for small guns. They have many advocates and many opponents. In recent battles we have seen several examples of the disastrous effects produced when they are struck by a heavy shell. But has this demonstrated anything, has it convinced their advocates that they are wrong? Not at all. I have always opposed the use of such shells, but I recognize that no new light has been thrown on the subject. Because in several instances whole gun's crews have been swept away by the bursting of a shell, otherwise harmless, against a shield, it does not follow that such shields may not, in the long run, save still greater numbers from being killed by small projectiles. If we wait for a so called "practical demonstration" of the advantages of every proposed change in naval construction, we shall always be in the rear. Who, giving thought to the matter, could have been ignorant of the danger which would arise in action from the use of great quantities of wood in warships—one of the first acts of Admiral Sampson, when he became Chief of the Bureau of Ordnance, was to call the Department's attention to this and urge a reform—yet we waited for the practical demonstration given by the battle of the Yaloo before we took any steps to remedy our mistake. The great improvement in the physical qualities of steel produced by the addition of a small percentage of nickel, and the successful manufacture of great quantities of nickel steel for armor, were sufficient proof that this material would be of great value in naval construction and in marine engineering, but when its use was urged the demand for a "practical demonstration" of its advantages carried the day, and though the first to benefit by the adoption of nickel steel for armor, we are likely to be the last to obtain the even greater benefits of its larger use.

If we wish to be in the van of progress we must act upon well considered conclusions drawn from past experiences, trusting that the future will confirm our judgment. If we refuse to accept any change until its advantages have been fully demonstrated by actual experience we must always be behind the times.

POSTSCRIPT BY THE AUTHOR.—When this article was written, nearly two years ago, it seemed likely that the new 6-inch guns, then just designed, would be a match for any secondary armor likely to be used on battle ships. The increase of such armor to 7-inch thickness in recent foreign designs, renders it essential that we shall abandon the 6-inch caliber for our battle ships, and the great question to-day is whether we shall substitute for it a 7-inch gun or an 8-inch gun. If we adopt the 7-inch, we can mount that caliber on broadside, but if we use the 8-inch guns, we must mount them in pairs in turrets. Personally I favor the latter plan, but it seems to me that the time is now ripe for careful consideration of the question whether we should not now abandon all guns of caliber between the 12-inch and the 3-inch, and revert to the old idea of having the fighting force of a battle ship consist entirely of heavy guns behind thick armor. When it is considered that only the unessential parts of a modern battle ship can be successfully attacked by any gun less than 8 inches in caliber, and that the abandonment of the intermediate guns and the armor placed for their protection would save enough weight to enable us to make all vital parts invulnerable as against anything below the 12-inch caliber, it becomes exceedingly doubtful whether we are acting wisely in exposing ourselves to defeat through demoralization by the destruction of auxiliary guns and their crews. About 2320 tons is the weight of the 6-inch and 8-inch guns, mounts, and ammunition, together with the armor defending them, on the Pennsylvania class, and, excepting to some extent the 8-inch guns, the only function of this immense battery is to attack the unessential parts of an opposing battle ship,—sweep it all away, and, excepting for the loss of life involved, your ship, so far as her power of destroying her opponent goes, is as powerful as ever. Why not, then, make our battle ships invulnerable to guns of moderate size, and arm them only with guns each hit from which means a real and possibly a fatal injury to an opponent. At least let us not put anything smaller than an 8-inch gun on any battle ship, excepting, of course, such small guns as are needed for torpedo defense.

P. R. A.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

MODERN ARMOR; ITS INFLUENCE ON THE DEVELOPMENT OF ORDNANCE.

By LIEUTENANT CLELAND DAVIS, U. S. Navy.

In an article published in the Naval Institute in 1897, the writer endeavored to briefly summarize the theory of resistance of face hardened armor, of the action of the projectile upon impact, and the effect of the cap.

Since that time the development of armor has been along the same lines, and the deductions therein given are applicable to present conditions. This theory is based upon the elastic property of the highly tempered supercarbonized face. When the point of the projectile reaches the face of the plate, the latter is elastically depressed or dished over a considerable area. The strain of impact is thus transmitted to the tough back, bringing to bear all the resisting power of that portion of the plate in wake of the dished surface to check the velocity of the projectile. When the limit of elasticity is reached, the hard face begins to give way, cracking along radial lines emanating from the point of impact and breaking off towards the circumference of the dish, causing the flaking or spalling characteristic of hard faced armor, and the subsequent operation is one of displacement of the molecules of the body of the plate by punching or boring of the shell. It must be remembered that the hard face is intact until the moment when the maximum depression is reached. The work done in dishing the plate reacts on the projectile, and if the latter has not sufficient remaining energy to absorb this reaction it must of necessity break up. A 5-inch uncapped projectile at 1800 f. s. striking velocity will not mar the surface of a 5-inch Krupp or Harvey plate. At 1825 f. s. there will be

In the present state of the art the manufacturers are unable to regulate the depth of carbonization and chill. Consequently the hard face is of the same thickness for all thicknesses of plate.

After the hard face is broken in, perforation occurs by boring or punching of the projectile, so that the effort should be to get a plate that would offer the greatest resistance to these effects. The theoretically perfect plate then would be of hard steel uniformly tempered throughout and tough enough to resist cracking. But this is impossible of attainment. So that the compromise after which the armor makers are striving is a plate with a maximum thickness of hard face combined with a minimum thickness of tough back that will bind the hard surface and prevent the whole from cracking

Now, the superiority of Krupp armor over the Harvey is mainly due to the composition of the steel used in the former, and this makes the plate more amenable to treatment, giving a tougher body and thereby making the plate less liable to crack, and at the same time increasing the depth of chill. This latter is by far the more important. Against uncapped projectiles there is a gain of from 15 to 20 per cent in resisting power. Against capped projectiles the effect of the hard face is practically nullified and hence the resisting power of Krupp and Harvey plates is about the same, the former having a slight advantage due to the fact that the projectile, after entering, has to pass through a greater depth of very hard steel, the molecules of which offer a greater resistance to displacement than those of the comparatively soft metal below the surface.

Following is a table showing the perforation of Harvey and Krupp armor by capped and uncapped projectiles from the latest types of naval guns with service velocities:

The perforations therein given for Harvey armor were calculated from formulae worked out by the writer in 1897, and agree closely with results since obtained. Strange to say, the formula for capped projectiles applies equally as well to Krupp as to Harvey armor, except for a very slight advantage in favor of the former for intermediate thicknesses of plates.

These formulae are:

Projectiles without caps. Capped projectiles.

$$V=\frac{a^{\frac{1}{4}}\,e^{\frac{3}{2}}}{p^{\frac{1}{4}}}K, \qquad V=\frac{a^{\frac{1}{4}}\,e^{\frac{3}{2}}}{p^{\frac{1}{4}}}K'.$$

TABLE OF ELEMENTS OF LATEST TYPES OF NAVAL GUNS (MODELS OF 1899). GIVING PERFORATION OF FACE-HARDENED ARMOR, SERVICE VELOCITIES, AT RANGES UP TO 3000 YARDS, WITH SMOKELESS POWDER. CAPPED AND UNCAPPED ARMOR-PIERCING PROJECTILES, AT NORMAL IMPACT.

Caliber of gun.	Weight in tons.	Length in caliber.	Total length in inches.	Approx. charge of smokeless powder for maximum vel. lbs.	Weight of projectile lbs.	Muzzle velocity. f. s.	Muzzle energy. ft. tons.	Perforation at muzzle.				Remaining velocity at 1000 yds.	Perforation at 1000 yds.				Remaining velocity at 2000 yds.	Perforation at 2,000 yds.				Remaining velocity at 3000 yds.	Perforation at 3000 yds.			
								Harvey nickel-steel.		Krupp armor.			Harvey nickel-steel.		Krupp armor.			Harvey nickel-steel.		Krupp armor.			Harvey nickel-steel.		Krupp armor.	
								Capped projectiles.	Uncapped projectiles.	Capped projectiles.	Uncapped projectiles.		Capped projectiles.	Uncapped projectiles.	Capped projectiles.	Uncapped projectiles.		Capped projectiles.	Uncapped projectiles.	Capped projectiles.	Uncapped projectiles.		Capped projectiles.	Uncapped projectiles.	Capped projectiles.	Uncapped projectiles.
3-inch Mark I.	.87	50	154.3	5	13	2800	709	4.4	3.6	4.4	3.6	2130	3.1		3.1		1620									
4-inch Mark VII	2.56	50	204.5	15	32	2900	1870	6.7	5.7	6.4	5.6	2380	5.3	4.4	5.2	4.4	1955	4.	3.4	4.	3.4	1605	3.2		3.2	
5-inch Mark V	3.3	50	255.	27	60	2900	3503	8.6	7.5	8.4	6.6	2460	7.	6.	6.7	5.6	2085	5.7	4.7	5.5	4.7	1770	4.6	3.9	4.6	3.6
6-inch Mark VI	8.37	50	300.	46	100	2900	5838	10.9	9.3	10.9	7.3	2525	8.9	7.7	8.8	6.8	2185	7.4	6.4	7.2	6.	1805	6.2	5.3	5.9	5.2
7-inch Mark I	13.33	45	315.	74	165	2900	9646	13.2	11.8	13.2	10.5	2580	11.4	10.1	11.4	8.9	2295	9.8	8.6	9.7	7.6	2040	8.5	7.4	8.3	6.5
8-inch Mark V	18.	45	343.	115	250	2800	13602	15.0	13.6	15.	12.1	2530	13.2	11.8	13.2	10.4	2090	11.7	10.4	11.7	9.1	2070	10.3	9.	10.3	7.9
10-inch Mark III	33.4	40	400.	240	500	2800	27204	20.	18.6	20.	17.1	2585	18.3	16.7	18.3	15.	2390	16.5	15.	16.5	13.5	2210	15.	13.	15.	11.5
12-inch Mark III	52.	40	493.	385	850	2800	46246	25.	23.4	25.	21.7	2620	23.	21.4	23.	19.4	2450	21.2	19.6	21.2	17.9	2295	19.5	17.9	19.5	16.2

Where V = Striking velocity in foot-seconds
a = Caliber of gun in inches
e = Thickness of plate in inches
p = Weight of projectile in pounds
log K = 3.34512
log K′ = 3.25312

It must be remembered that the thickness of armor given just matches the velocity, so that it may be assumed that the projectile is just defeated, that is to say, under normal conditions of plate and projectile, the latter would be broken up and lodge in the backing, and so fail of its purpose of getting through the armor and exploding inside the vessel. In other words, armor of those thicknesses offers a sufficient protection against the corresponding guns. To insure complete perforation, the projectile passing through and remaining intact, from 100 to 200 f. s. should be added to the velocities given.

There are but meager data as to the effect of the very high velocities. It is believed, however, that for these high velocities the thicknesses given are in favor of the armor. As the velocity increases the energy increases as the square of the velocity, there is less strain on the projectile, and the resisting power of the plate decreases due to the fact that the time element limits the area of distribution of resistance. The perforating power therefore varies as the (1 plus x) power of the velocity.

The function of armor is, first to prevent holes being made at or immediately below the water-line, and in this function it is assisted by the construction of the vessel and by the use of water excluding material. Second, to protect the machinery and the guns of the vessel. Third, to protect the personnel. This last is held by a great many officers to be the most important of all and the writer, too, is inclined to this view, having due regard for the importance of the others.

The most formidable feature of the gun is admittedly its ability to throw a shell charged with an explosive at sufficient velocity and of sufficient strength to perforate armor and backing intact and explode on the inside of the vessel. All other methods of attack at or above the water line can readily be defeated by the armor now being placed on battleships, except solid shot, which is now being abandoned by all services.

The use of high explosives against the outside of the armor has many advocates. But all experience goes to show that the only result is the cracking of the plate, and this is what would be expected from a careful consideration of the action of the force generated. Detonation is produced by wave action within the mass, and the result is a gas which, on expanding in the attempt of the molecules to assume normal relations with respect to one another, is capable of doing work. The direction of this expansion can sometimes be controlled by what is known as tamping, and the force of expansion concentrated in a definite line, but even then the force decreases in power with tremendous rapidity. Now, assuming that the high explosive is fired from a powder gun, which seems to be the only practicable method of projecting it, means must be provided for properly containing the charge, and for detonating it at the right moment so that the force generated will act in the right direction. All this is extremely difficult of accomplishment, if not impossible. If successfully accomplished, there remains the effect of the explosion on the plate. We have on the one hand the great mass of metal in the plate, the molecules of which are extremely tenacious, and on the other, a column of gas the molecules of which are moving individually at the rate of 20,000 feet a second. This column strikes the plate with a sudden blow and thus transmits a considerable shock that may be sufficient to crack or rupture it along its weakest lines. But this column of gas is not a coherent mass, and as a mass possesses little or no inertia, and, when the molecules at the head of the column strike, having no tenacity, so to speak, and so being unable to displace the molecules of the steel by shearing or punching, they must of necessity react upon the molecules of gas in the rear or spread out laterally;—and thus is the force expended, constantly decreasing until the whole is dissipated. And the time consumed in the whole operation is so small that I believe that the heaviest charge it is practicable to explode against a large plate would be barely sufficient to overcome its inertia, so that there would be little or no strain transmitted to the structure behind armor. In the case of thin plating, in the bottom of a vessel, the first shock is sufficient to tear a hole in the plate, thus opening a way for the gases behind to pass through and do their work.

The foregoing remarks suggest the probable lines of development of armor and ordnance in the immediate future. First as to armor. It must be remembered that the primary function of armor is to prevent explosive shell from passing through it and exploding in the interior of the vessel. This is being recognized, as is shown by the tendency to decrease the thickness of armor classified as hull protection, and increase the thickness of that for gun protection. In a very short time I expect to see our battleships with casemate armor eight or nine inches thick.

Now the most efficient armor for preventing projectiles from passing through it intact will be made of steel that offers a maximum resistance to shearing of its particles, that is, to boring or punching. For this purpose it should be very hard, perhaps not all the way through for that is now impracticable, but at least to a considerable depth below the surface, even at a sacrifice of toughness with the consequent liability to crack.

Strange to say, while armor has been developed so as to increase its efficiency in a remarkable degree, the projectile of today is of the same design and but little improved in quality over that of ten years ago, before the advent of face-hardened plates.

With the idea of increasing the strength and at the same time preserving and even increasing the capacity of the powder cavity, the writer has designed a new form of shell which it is hoped will give increased perforating power and at the same time be well conditioned for bursting effect. The cap will be retained, for it is the simplest, and at the same time probably the most effective device ever developed in the history of ordnance. The object of a bursting charge in a shell is primarily to burst the shell, and it is the fragments of the latter that do the damage. It is possible that the flame of the charge may set fire to light inflammable substances with which it might come in contact, but fire is almost invariably produced by heated fragments of the shell.

The use of high explosives in shell is only of value in that the shell may be made stronger by decreasing the size of the cavity, thus giving greater perforating power. But a detonating explosive is so difficult to control that an explosive of the second order would seem more desirable as a bursting charge for shell, even at some slight sacrifice of strength of the latter.

The development of the armor piercing shell contemplates a shell that can be sent through face-hardened armor, a caliber in thickness, at 3000 yards, with service muzzle velocities, and exploded beyond, and this is in process of accomplishment.

The tendency is towards the adoption, for the main and auxiliary batteries of battleships, of capped armor piercing shell only, fuzed and loaded with smokeless powder, and, for cruisers, a proportion of these with cast or forged steel shell, fused and loaded with black powder and capable of piercing intact armor one half a caliber in thickness.

The value of high velocity cannot be overestimated, especially with respect to the perforating power of the projectile. It would seem that the limit of velocity has been nearly if not quite reached with the present design of gun. The conditions of mounting on board ship limit the size and length of each caliber. The ideal gun is of course a thick cylinder with the curve of the powder pressure a straight line parallel to the axis of the bore. But up to the present time no powder has been developed that will even approach these conditions. Having settled upon a colloid powder, further development should be in the direction of the form of charge. There are a great many objections from a theoretical ballistic standpoint to the present form of grain. It would hardly be pertinent to discuss these here; but it must be remembered that when smokeless or colloid powders came into use, guns were of a settled type, and the powder had to be made to fit the gun. The writer is of the opinion that we should endeavor to get a powder having the best theoretical ballistic qualities and then design the gun to fit the powder. This would seem to be not impossible of accomplishment and the prediction is ventured that 4000 f. s. will be the service muzzle velocity at no very distant date.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL RECONNAISSANCE IN TIME OF PEACE.

By LIEUTENANT JOHN M. ELLICOTT, U. S. N.

When war threatens with a maritime power, our navy will be called upon to prepare a plan of campaign. To do this it is not sufficient to know the numerical strength of our opponent's navy, the distribution of his forces and the characteristics of his warships; but we should also know the strategic value of all his ports, harbors and naval bases, and their tactical strength, weakness and resources. We should know the same of all such places belonging to any neighboring country to our opponent or to his outlying possessions, and of all such places lying between us and him; and we should know the same of our own ports and harbors. This knowledge cannot be acquired after war threatens or breaks out; there will be neither time nor opportunity. The barest common sense dictates that it must be obtained, if at all, in time of peace; and a little prudent foresight suggests that it should not alone be obtained, but classified, filed and kept up to date in the most persistent, painstaking and methodical way, so that it shall be but a matter of a minute to lay the Government hand upon any portion needed.

We have had in the aggregate, more than a hundred years unmarked by war, during which our naval vessels have visited nearly every port in the world, and have lain in them weeks and sometimes months at a time. Throughout such periods our officers, educated to the highest pitch of professional mental attainment, have spent much of their time keeping their ships scrubbed and swept, and having bells struck to mark accurately the hours thus intellectually wasted. Their very limited periods of time allowed on shore are naturally and almost necessarily

spent in recreating for further arduous misapplication of professional ability on board. There is scarcely an instance in our aggregate hundred and odd years of peace, of an officer being given the opportunity and the instructions to put his specially trained intelligence to work to study the feasibility of capturing or defending the ports visited, and to learn their strategic value in probably maritime wars; yet such study is one of the first natural and essential preparations for war, and it is for war that the officer is trained and the ships are built. There is, to be sure, nowadays, and has been for some few years, an intelligence officer, detailed from among the ship's complement, who is directed to gather information concerning foreign men-of-war, arsenals and dockyards when he falls in with them, and, incidentally, some general information concerning ports. This, however, he must usually do in addition to his other duties, or be regarded with suspicion by his captain and messmates as shirking a watch if he asks for special opportunities. Even when he succeeds in finding time to do his intelligence work, he is furnished with neither outfit nor adequate funds, and his instructions are seldom more than to seek details of armaments and mechanical equipment. These are, of course, important, but even if we learn such details concerning a fortified port, they are of little use to us without that knowledge of its environment which will enable us to make plans for its capture. Such knowledge can only be acquired by reconnaissance.

Reconnaissance may be defined as the process of obtaining information for war purposes. If made in the presence of the enemy it is termed *tactical reconnaissance* or, when conducted in spite of opposition, *reconnaissance in force*. It is not of these that this paper will treat, but of the wider branch of *preliminary reconnaissance*.

All military students and writers agree that the marvelous success of the Prussian army, in 1870, was largely due to the thoroughness of preliminary reconnaissance made during the years of peace following the downfall of Napoleon I. The magnificent demonstration given in 1870, of the decisive results of such work, has led the German and other governments to perfect it as a branch of war preparation. Derricagaix tells us in his work on "Modern War":

"The general staff at Berlin contains three sections specially

charged with attentively following all military movements both at home and abroad, for the purpose of keeping themselves informed concerning everything touching organization, recruitment, armament, equipment, the geographical configuration of neighboring countries, the construction and demolition of fortresses, the development of ordinary roads, railroads, canals, etc.

"The countries of Europe are distributed among these three sections and form subjects of special study.

"This organization has been adopted by all armies since the success of Prussia demonstrated its utility."

Reconnaissance, then, is carried on in time of peace by the military branches of all foreign services as an important, a necessary preparation for war, despite the fact that general military reconnaissance can, to a considerable extent, be carried on after war breaks out. It is vastly more important that preliminary naval reconnaissance should be so conducted, for after war breaks out, all naval reconnaissance is blocked at the shore line; yet it seems that thus far no nation in the world has a thoroughly organized system of naval reconnaissance as a preparation for war. This is due to the fact that, until the publication of Captain Mahan's great work, only a few individuals ever realized the influence, the importance of sea power. As might have been expected, Germany then saw at once that what had so largely contributed to her victories on land, must form part of her preparation to fight battles on the sea, so that her Naval General Staff is now working, just as the Prussian Military Staff did before 1870, at preliminary reconnaissance as part of its preparation for naval war, and several other countries are unquestionably following Germany's example.

Our neglect of naval reconnaissance has not yet resulted seriously, because, until now, we have been an isolated power in the community of nations, content to keep our enemies from our home coasts and to busy ourselves with internal development. Now, that condition has passed away. We have taken a colonial empire from a decadent world power, and on the confines of that empire we find ourselves touching elbows with every nation in the world. Our commercial and political relations with other powers are now so interwoven that war may threaten with any of them when our national interests are divergent from theirs. We should, therefore, hasten to repair the neglect of more than

a century, and begin at once, in a comprehensive, systematic way, to learn where and how best to carry war into countries beyond the seas. Colonel G. A. Furse, in his valuable work on "Lines of Communicating in War," says:—

"The disembarkation of an expeditionary force may have to be effected in a country of which we may possibly have a very superficial knowledge. . . . In cases of this kind, it becomes essential to have careful reconnaissance of the coast made by naval and military officers, to whom should be entrusted the selection of a suitable place for landing, which may subsequently be turned into a base of operations, if necessary. . . .

"Sound arrangements at the base of operations are impossible unless we have a correct idea of all the difficulties which we shall have to contend against, for without this it is obvious that we shall never be in a position to devise the most practical means for overcoming them."

Even more pressing to us just now is the necessity for learning how to prepare to defend our new and distant possessions, for these will be jeopardized first, in the event of a maritime war, and they are of vital importance to us in carrying on such a war. Our most exposed, and, strategically, our most important outlying possession today is the Philippine Group of islands. We should select in it, without delay, the tactically strongest locality for a naval base, in the best strategic position. There are scores of excellent harbors among these islands. All should be visited and most of them examined by careful reconnaissance before a selection is made; for if we miss the key by a hasty selection, our opponent will probably seize it when war comes. I have already said that other nations have not neglected reconnaissance as we have. I have seen British, German and Japanese naval officers, many miles from harbors in which their ships were lying, equipped with bicycles, cameras, sketch pads and compasses, busily engaged in studying the characteristics of the country about them, while midshipmen and warrant officers were keeping their ships swept in their absence.

I repeat that in selecting a naval base in the Philippines we must be absolutely certain that tactically and strategically we have selected the best, for when war comes, our opponent in those waters will assuredly make for himself a selection from among the harbors we fail to fortify.

The Aleutian Islands loom up in strategic importance when our eyes turn to the Far East; yet, in spite of the almost countless naval vessels which we have sent from time to time for various purposes into Bering Sea, we know next to nothing of these islands and their harbors. We have been content to leave them shrouded in fog and obscurity; but the big merchant steamers of Great Britain and Japan are sighting them almost daily. They are half way stations on the shortest highway between us and Asia, and must assuredly be used by ourselves or our enemies whenever the Pacific becomes our theater of war. There are probably not half a dozen captains in the United States Navy today, who, if passing the Aleutians with a convoy, would know in which island they could find the best shelter for coaling and refitting.

We still have much to learn of the Hawaiian Islands and of our West Indian possessions, as well as of the harbors of our continental coasts; in fact naval reconnaissance at home and abroad has been, as I have endeavored to show, entirely neglected. How then should we go about this imperatively necessary preparation for war?

Instructions for reconnaissance duty have been prepared at the Naval War College, and each summer the class, in attendance has been sent out for a few weeks at a time to make practical application of them in the vicinity of Newport. Instructions of a similar nature were formulated several years ago in the Office of Naval Intelligence for the guidance of intelligence officers afloat, but their importance has been so little appreciated that they are the least heeded of all intelligence instructions, and now need revision. These two sets of instructions, compared and revised, should be sent by the Navy Department, as confidential matter, to commanders-in-chief and commanding officers of vessels in commission. It should then be ordered, and the order should become a paragraph of the naval regulations, that whenever vessels of the navy are lying in port in time of peace, the senior officer present shall direct that watch officers be, as far as practicable, relieved from watch duty by junior and warrant officers, and shall assign them to a reconnaissance party under the direction of the senior member, which shall draw up and carry out a systematic scheme of naval and military reconnaissance in accordance with the "In-

structions for Reconnaissance Duty," and make a report on the same, embodying all sketches and plans formulated for offense and defense; such work, however, not to relieve officers from regular forenoon or special drills, when this can be avoided. The reports should be confidential and in quadruplicate, one copy going to the Navy Department, one to the Naval War College, one to the flagship of the station, and the remaining one to be deposited, under seal, in the safe of the chief official in charge of the maritime interests of our government in the port examined (for example, the U. S. Consul, or the Captain of the Port, according as it is a foreign or a home port), for inspection and revision by the next reconnaissance party visiting that port.

I have said that both a naval and military reconnaissance should be made by these parties, because no representatives of the army are likely to visit foreign ports or even ungarrisoned home ports in an official capacity in time of peace, and the navy may have to convoy and land the army before it can begin operations in time of war. It is, therefore, important that whenever possible a marine officer should be a member of the reconnaissance party.

The intelligence officers should also be members, and such portions of the information obtained as they might select, or perhaps all of it, should go through the usual official channels to the Office of Naval Intelligence.

In a reconnaissance, to be thoroughly successful in execution and valuable in results, the following conditions are necessary:—

(*a*). Previous careful study of the best charts and maps of the locality.

(*b*). Distinct orders to all detachments of a party as to what is required.

(*c*). Thorough equipment.

(*d*). Some aptitude in free hand sketching.

(*e*). Ability to ride a horse or a bicycle, or both.

(*f*). Familiarity with the language of the country.

(*g*). Tactfulness.

Instead of discussing these questions in the order named I will take up the subject of free hand sketching. Such work done in reconnaissance by one whose intelligence has been tactically trained will prove a saving in time and labor, and the quickest and surest way of conveying much of the information he gathers.

Captain E. A. Root, U. S. A., in his work on "Military Topography and Sketching" says, on the subject of reconnaissance:—

"However pressed for time one may be, *he should try* to convey as much information by *a sketch* as circumstances will permit."

In a reconnaissance of a harbor, two or three profile sketches from the various directions of approach by sea, and a birdseye sketch from the most commanding height in the harbor's environment would often save many pages of tedious description; but the officer making the sketch must fully understand the purposes for which it is made and the details needed for such purposes. To this end his education in this line should begin at the Naval Academy, and in the Department of Drawing at that institution such works as those of Captain E. A. Root, U. S. A., and Major H. D. Hutchinson, R. A., should be used as text-books, and sections should be taken out frequently along the Severn River and Chesapeake Bay for practical exercise in reconnaissance-sketching and the use of all reconnaissance equipment.

Of course such work can often be much better done with a camera, but a camera is not always available, not always in order and not always convenient to handle. Moreover, it is frequently handicapped by the caprices of the weather, such as cloudiness, rain, haze, the relative direction of the sun or the prevalence of a strong wind. Nevertheless a section at the Naval Academy, while doing practical work in reconnaissance-sketching, should also receive practical instruction in reconnaissance-photography, This practical work in the *application* of the art in the Department of Drawing need not conflict with the *teaching* of the art by another department, if that is now the case.

Reconnaissance should not be confined to the immediate vicinity of a port, but should extend ten, twenty or a hundred miles around it, if necessary, to develop any important tactical characteristics. Money should be made available, either from the naval contingent or a specially appropriated fund, to equip reconnaissance parties and to pay all their expenses of travel and subsistence. Each member of a properly equipped party should have: 1 bicycle, with cyclometer; 1 sketch pad; 1 note-book; 1 foot rule; 1 pocket compass; 1 pocket aneroid barometer; 1 pair binoculars; 1 pocket camera; 1 road map of the locality; a passport; and the chief of the party should be authorized to pur-

The location and characteristics of sites for camping grounds and for field hospitals.

The location, equipment and resources of manufacturing, repairing, coaling, watering and lighting plants.

The number, tonnage and speed of local steamers, ferryboats, tugs, yachts and launches, and the number and tonnage of all sailing craft, barges, lighters, etc.; also their draft.

Roads; their directions, nature, width, condition of repair, grades, intersection with other roads; how bordered; where they pass through defiles or cross streams or railroads.

Railroads; their direction; number of tracks, guage, grades, junctions, stations, cuts, embankments, tunnels and the number and capacity of locomotives and cars.

Bridges; their position, construction, height and width of spans; the load they will bear and their fairway width, and the characteristics and location of positions commanding the bridge heads.

Rivers and streams; their direction, width, depth, fords, rapidity of current, fluctuations in depth (indicated often by driftwood), nature of banks; location and nature of islands in them. heights and cover commanding channels; character of the water (potable or otherwise).

Woods; their situation, extent and timber; whether clear or containing underbrush; location and extent of clearings, ravines, marshes, etc.

Canals; their direction, width and depth; location and length of locks; condition of towpath; location and height of bridge arches over them.

Routes of telegraph and telephone lines; number of wires and location of stations.

Villages; characteristics of their situation and architecture; width of streets and materials of pavements; location and nature of buildings commanding best view of surrounding country, or specially suited for strongholds.

The location and characteristics of defiles, ponds, marshes, springs, valleys, and heights; always noting from the latter what other heights or landmarks are visible.

The nature of cultivation.

Information concerning climate, weather, healthfulness and local food supply.

It is to be kept in mind that most of this information is to facilitate the movement of troops and supplies from a landing place to a field of operations, and to place the troops in possession of the commanding positions on that field. The officers making such reconnaissance must have some knowledge of what troops can do on a march, what inclines they can ascend or descend, what depths they can ford; the extent of obstructions which will bar the way to various kinds of impedimenta. For example, they should know that the limit of fordable depths is laid down as 3 feet for infantry, 4 feet for cavalry and 2½ feet for guns; that 3 inches of sound ice is regarded sufficient to bear infantry and field artillery, and 7 inches sufficient for heavy guns; and that slopes up to 15 degrees are practicable for movements of all arms in close order, thence to 30 degrees are traversible only in irregular formations, and thence to 45 degrees can only be climbed singly.

In this connection it is important to note, of villages, if the houses are compactly grouped, or straggling, or strung out. and, if the latter condition prevails, whether the attenuation is along a line of march or at right angles to it. It is important to take note of similar characteristics in woods and marshes.

In judging of camp sites it is important to note the drainage, dryness of the ground, etc., for sanitary purposes.

All chart data and sailing directions should be verified or corrected and made complete.

My resumé of information to be obtained by reconnaissance is not complete, but serves to show how much is to be sought in a thorough reconnaissance. Some of it seems at first sight to be out of the province of a naval officer, but as he alone, in most cases, has the opportunity to obtain it on foreign shores, *he* must do it if we are to have such information at all.

As already suggested, our most pressing need for reconnaissance today is to select permanent bases in our new possessions. In considering harbors for this purpose they can be divided into four classes:

1. Single exit harbors.
2. Double or multiple exit harbors.
3. Single basin harbors.
4. Double or multiple basin harbors.

Class No. 4 may be subdivided into—

a. Serial basin harbors.

b. Radial basin harbors.

The following will serve as illustrations:

No. 1: San Francisco, Santiago de Cuba, or Subic Bay.

No. 2: New York, Kure, Hong Kong and Ilo Ilo. No. 1 and No. 2 illustrations are also single basin harbors.

No. 4*a:* Malampaya Sound, Philippines, and Guantanamo, Cuba.

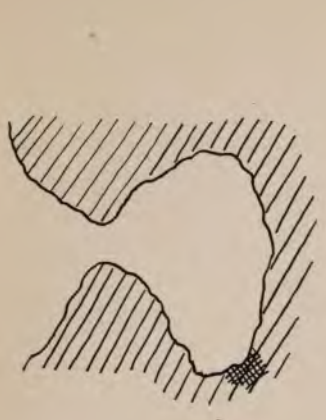
No. 4*b:* Pearl Harbor, Hawaii, and Sam-Sa Bay, coast of China.

Tactically, the ideally strongest harbor for a permanent naval base would be of the multiple, radial basin kind; the exits being numerous, fortified and debouching far apart; the basins so located as to be masked in the directions of the exits.

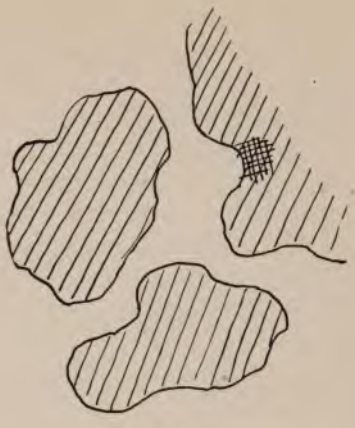
If the exits debouch a hundred miles or more apart it would require a force at every exit equal to the force inside, to effectually blockade it, or, in other words, the blockading force would have to be as many times greater than the blockaded force as there are exits. There are very few harbors possessing more than three exits; in fact I cannot call to mind any. Nantucket Sound and Kure are examples of those having three. It is great tactical good fortune to be able to select one having even two. We have but two such localities on our Atlantic coast, Long Island Sound and Nantucket Sound (excepting a small one in Penobscot Bay), and there is but one, Port Orchard, on our Pacific coast, which, after all, is itself enclosed by a single exit harbor. Japan is lavishly blessed with such harbors on her Inland Sea.

If we are forced to select a single exit harbor, it should be one whose inner basin is not open to reconnaissance or bombardment through its exit; one shaped like Pago Pago, for example, which is L shaped, the axis of the inner basin being nearly at right angles to the axis of the exit. The exit must be narrow enough to be controlled by gun fire, and not too deep for mines, and it should rapidly widen beyond the line of fixed defenses, so that a fleet issuing forth could quickly deploy into any line of battle. It should widen just as rapidly into the harbor itself, so that the period of constriction during exit may be the briefest possible.

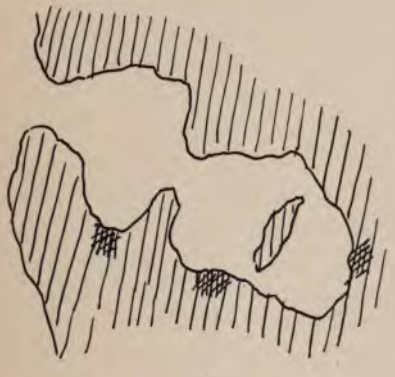
A serial basin harbor affords natural lines of fixed defenses at every point of constriction between the basins. If only one of



1.



2.



3.

4.

5.

these lines can be defended it should be the outer one, unless the next inner one possess such superior characteristics that it can be made much the stronger, and that its defenses make the outer basin untenable to the enemy; for it is imperative that the latter should nowhere find undisputed harbor in the vicinity of his blockade.

A radial basin harbor may possess advantages over a serial basin harbor, if all basin entrances are defended and there are water traverses connecting the rear ends of the basins, for then the blockaded fleet would still possess some mobility after the outer exit had been carried, especially in torpedo boat attack, which might be made upon the enemy from any or all of the basins having connections in their rear.

The first considerations in the selection of a permanent naval base are, of course, strategic.

It should be on or near our lines of communication.

It should be centrally located, with reference to all routes by which the enemy might enter the area under its control.

It should include within its fixed defenses a district of domiciled, skilled labor, and resources for subsistence and repair.

Let us take, for example, the Philippine Islands. Our lines of communications through the group to any theater of opertions on the Asiatic coast would run from Guam through the Strait of San Bernadino or Surigao. Thus, we see, they would pass just north and just south of the island of Panay. Looking next for the most central position with reference to all water routes by which an enemy's naval forces could enter the Philippine group, we find it to be the island of Panay. Looking next for the centers of domiciled skilled labor in the islands, we find there are but two; Manila, in Luzon, and Ilo Ilo, in Panay.

All strategic considerations have, then, pointed to the island of Panay. We have next to look for its harbors. It has but one worthy of the name, Ilo Ilo; let us then examine its tactical characteristics.

It is a single basin, double exit harbor; the exits debouching nearly thirty miles apart at the north and south ends of the island of Guimaras. The harbor is completely masked in a semicircular bight of Guimaras, and the exits are suitable for the strongest defenses of all kinds. We might be well content with these characteristics, but, looking a little closer, we find only a narrow

strait between the small island of Guimaras and the large island of Negros, and this strait has only 17 feet of water in its deepest part. Ilo Ilo is then, tactically, a harbor enclosed between the islands of Panay and Negros, with exits separated by almost the entire circumference of either of those islands; in other words, its exits debouch three hundred miles apart.

Having by a general reconnaissance selected the strongest strategic and tactical locality for a naval base, further special reconnaissance must be made to select sites for drydocks, repair shops, coal wharves and sheds, reservoirs, barracks, magazines, storehouses, and hospitals. The local hydrographic and topographic conditions must largely govern in this, but there are tactical conditions too, which must not be disregarded.

1. The site should be safe from bombardment by blockading vessels, and should be naturally masked from outside reconnaissance.

2. The establishment should be so laid out that there will be no congestion of vessels along its water front.

3. If there is a choice between an insular and a continental side of the harbor, the former should generally be chosen, especially if the base is in an unfriendly or insurrectionary country. This was found necessary by the British at Hong Kong.

4. The site should be so located that projectiles aimed at its defenses will not place its establishments in jeopardy.

The site having been selected, reconnaissance for its defense is next in order. It may be claimed that this is work for the army engineer, but he will not be on the spot, and may never be sent to the spot until the naval officer there calls attention to its tactical defensive characteristics. Naval reconnaissance must, therefore, select the general locality, leaving to the engineer's technical knowledge the adoption of the exact sites. In selecting a general locality for fixed defenses the following conditions suggest themselves:

(*a*). The first site to be selected is one which gives axial fire down a channel, such as an island in midchannel or a point of land projecting into it.

(*b*). The next position should be one whose fire will cross the axial fire of the first, *i. e.*, on one bank or the other of the channel, and it should be close enough to the first to deliver its most effective fire simultaneously with that from it.

(*c*). The choice between banks being otherwise equal, it is better to place all batteries on one bank only, instead of dividing them between the two, for this will concentrate all fire upon one side of an incoming fleet, and permit it to fight but one broadside in return. It also eliminates the possibility of batteries firing into each other, and facilitates intercommunication and control of fire.

(*d*). There should be fixed defenses on any salient point causing a sharp bend in a channel.

(*e*). There should be fixed defenses commanding the offing, especially if it contains anchoring ground.

(*f*). The height of fixed defenses above water must not be too great for guns at extreme depression to cover the nearer side of the channel.

(*g*). In selecting heights for fixed defenses, that one should be chosen (if not too high) which commands all others in its neighborhood; otherwise provision must be made to hold the position commanding the selected site with an adequate mobile force.

(*h*). It should be arranged that the aggregate fire from all batteries in supporting distance of each other in any locality shall be at least superior to the broadside of two standard battleships, especially in lighter caliber guns, which cannot be too numerous.

(*i*). The caliber of guns in a battery should be in proportion to the range within which the constriction of the channel will compel the enemy to pass.

(*j*). Sites must be selected for searchlights and mine fields, and for batteries to cover the latter.

Many portions of our new possessions are incompletely or inaccurately surveyed. This is also true of many other parts of the world, especially those waters of Asia which are now near the focus of international speculation. Surveys must be preceded by reconnaissance, and the outcome of the surveys will be charts and sailing directions. On the threshold of such work we should realize, that *charts and sailing directions are weapons of strategy and tactics.* A hydrographic chart prepared by or for the navy should be as complete a military map as one prepared for a land campaign. Its features should not cease at the shore line, but every characteristic of contour, roadways, streams and bridges, fords, woods, swamps, cultivated fields, villages, tele-

graph, etc., within the area covered should be shown. The scale and size of charts should be an outcome of strategic study. Sailing directions have an equal military value. Unfortunately, with the decadence of sail power, they have grown briefer and briefer, but it should not be so. Sailing directions should be regarded as supplemental reports of naval reconnaissance and should be prepared accordingly. This emphasizes the fact that hydrographic surveying should be conducted by naval officers, for it is essentially and especially strategic work.

Of all things which contribute to the success of a military undertaking, preparation is most important, and to no country is preparation more important than to ours, with our meager experience, our naturally peaceful pursuits and our new and dangerous propinquity to the great nations of the world. A former president of the War College has given the formation of plans of operations as one of the three principal branches of preparation, and he places the study necessary to the formation of such plans under three heads, historical, statistical and geographical. Von Moltke has declared that geography is three-fourths the science of war, and the only way we can study geography for military and naval purposes is by reconnaissance. The Prussian staff officers devoted themselves to elaborate studies of strategy and geography, not only by means of books, but by travel, and following in person each campaign. Dr. T. Miller Maguire, in his "Outlines of Military Geography" speaking of the rapid triumph of Prussia over France, in 1870, says:

"How was this? Simply because for a generation the leaders of the German race had devoted themselves with constant zeal to profound studies of strategy and military geography in all its bearings, and during the struggle had acted on the knowledge thus acquired. They were ready for war in its most highly developed form; their adversaries were neither as well trained nor as well prepared. There was no other reason." What the Prussians did, the Germans are still doing, and the British and Japanese are learning to do likewise. Can we, who are elbowing all three nations with a jealous fear that they are crowding us, afford to be behind them in any branch of preparation for war?

The United States has led the world in the study of the art of naval warfare, and this study brings out clearly the analogy of methods on sea to those on land. Von Moltke has shown that

preliminary reconnaissance is one of the greatest sureties of success in land campaigns. Let us who follow the sea be no longer blind to the lesson which this, by analogy, teaches, but let us get away among the first on the road to preparation in this important field. After a few years of such work if carried on energetically and systematically, there would be, in the cabin of the commander-in-chief or senior officer present on every one of our warship stations such carefully prepared information concerning every locality within the limits of the station that if war came like a thunderbolt from a clear sky his plan of action could be correctly mapped out while getting up anchor.

Never more keenly, perhaps, has the lack of preliminary naval reconnaissance been felt in our service, than by the staff of the commander-in-chief of the naval force on our Asiatic Station when war so suddenly threatened with Spain in the spring of 1898. On February 25 of that year the following telegram was received:

"DEWEY, HONGKONG:

In the event of war with Spain, your duty will be to see that the Spanish squadron does not leave the Asiatic coast, and then offensive operations in the Philippine Islands.

ROOSEVELT."

Here was a theater of operations outlined with mandatory abruptness. What was known about that theater? Only what could be gleaned from unreliable charts and antique sailing directions. The fortifications of Manila and Cavite had been open to inspection for a decade of peace years, and the characteristics of Manila and Subic Bays, of Ilo Ilo and other ports, could have been studied from the days of Perry, but no American Von Moltke existed in our navy. It was too late to begin naval reconnaissance then; in fact, as we all know, relations between the two countries had been so long strained that it would have been too late a year earlier. There was but one possible way to make up in some degree the lack of knowledge, viz., through the U. S. Consul at Manila, a man naturally in no sense trained for military or naval reconnaissance. Consequently we soon find the following sequence of telegrams:

"WASHINGTON, April 24, 1898.

"DEWEY, HONGKONG:

War has commenced between the United States and Spain. Proceed at once to the Philippine Islands. Commence operations at once,

particularly against the Spanish fleet. You must capture vessels or destroy. Use utmost endeavors.

LONG."

HONGKONG, April 25, 1898.

"SECRETARY OF NAVY, Washington:

The squadron will leave for Manila, Philippine Islands, immediately upon the arrival of the United States consul from Manila.

DEWEY."

HONGKONG, April 27, 1898.

"SECRETARY OF NAVY, Washington:

Williams, the United States consul from Manila, has arrived. The squadron will sail immediately for the Philippine Islands.

DEWEY."

Extract from Commodore Dewey's report on the Battle of Manila:

"The squadron left Mirs Bay on April 27, immediately on the arrival of Mr. O. F. Williams, United States consul at Manila, who brought important information and who accompanies the squadron."

Here, then, was a commander-in-chief, one of the most energetic, audacious and resourceful our navy has ever produced, fully ready for battle in all other respects, compelled to wait two days after urgent commands to open his campaign, in order to obtain that knowledge of the enemy's country and resources which, had our navy had a system of preliminary reconnaissance, should have been lying all the time in a drawer of his desk. The information finally obtained was as it could not otherwise be, so meager and imperfect that only the inspiration and resolute action of our great leader made our success complete.

The inadequacy, indeed the paucity, of our topographical knowledge of the environment of Santiago de Cuba in the spring of 1898, is well known, and the impossibility of completing such knowledge after war broke out was fully demonstrated. Let us take to heart the lessons thus taught and try to realize how narrowly we escaped the consequences of our neglect, and let us begin at once with the utmost effort to repair that neglect before we are again caught in the predicament of war.

Preliminary reconnaissance is practically at an end when war becomes imminent. Tactical reconnaissance may begin when war breaks out, but there are widely different limits to naval tactical reconnaissance and military tactical reconnaissance. The latter, conducted on land, with many chances of concealment, and in frequent touch with disaffected people in the ene-

my's country, will generally result in much valuable information, sometimes going far toward making up for the neglect of preliminary reconnaissance, but naval tactical reconnaissance must be confined to the enemy's coast line, with no possibility of concealment and with little intercourse with noncombatants on shore. There may be occasional daring and fruitful exploits like that of Lieutenant Blue at Santiago, and Lieutenant Ward in Porto Rico, but they can only at best be rare. Beyond such, nothing can be done except to draw the fire of the enemy's batteries and fortifications as was done by Admiral Sampson at San Juan, and endeavor in the excitement of action to locate gun positions and estimate the caliber of the projectiles hurled from them. Of the San Juan bombardment Admiral Sampson reports:

"I determined to attack the batteries defending the port, in order to develop their positions and strength, and then turn to the westward."

Twelve hundred and twenty-five projectiles were expended upon San Juan for this purpose, with the result that "all the shore batteries had been developed, and they were more numerous than the information received had led me to suspect" (Admiral Sampson's report). One man had been killed in this reconnaissance, and seven or more wounded, while seven U. S. warships had been for two and a half hours in danger of destruction. Such is the risk and cost of tactical naval reconnaissance, and such are the meager results when it is made to repair the neglect of reconnaissance preliminary to war. Had there existed in our navy a well developed system of preliminary naval reconnaissance, even for but five years previous to 1898, Admiral Sampson might have had the information he sought before the war broke out, and it would have cost less than fifty dollars.

For the navy, *tactical* reconnaissance can never make up for the neglect of *preliminary* reconnaissance. The chief value of naval tactical reconnaissance and reconnaissance in force will be to gain information concerning the enemy's fleet and other forces on the seas.

I present this paper in the hope that it may be a seed which will quicken into a system of naval reconnaissance in time of peace unequalled in its scope and completeness by any in the world, for "in nothing more than in war, knowledge is power."

A NEW RIVER GUNBOAT.

A shallow-draft river gunboat, one of two just built for the British Government by Messrs. Yarrow, was taken for a trial run in the Thames from Greenwich to Gravesend and back on Saturday afternoon, when there were present on the ship among others, Adm. Sir R. H. M. Molyneux, Vice-Adm. Morant, the Turkish Ambassador, Capt. Schilling (French Naval Attaché), Com. Schwarz (Austrian Naval Attaché), Com. Kawashima (Japanese Naval Attaché), Capt. T. Matsuo (Japanese Chief Naval Constructor), Sir Hiram Maxim, and Prof. W. C. Unwin.

The great feature of the Teal, as the vessel is named, is the smallness of her draft, which does not exceed 2 feet 3 inches; on her official trials, indeed, it was only 2 feet 2¼ inches with a load of 40 tons on board, and yet the mean of six runs on the measured mile showed a speed of 13.045 knots, or 15.014 statute miles an hour. This speed was attained without forced draft and when the fuel burnt was wood. The Teal is 160 feet long and has a beam of 24½ feet. Her hull, which is of galvanized steel, is divided into ten water-tight compartments, each of which is an independent flotable section—a system of construction which enables the vessel to be put together while afloat and avoids the inconvenience of riveting up and launching in localities where skilled labor may be unobtainable. There are two screws, driven by two sets of compound surface-condensing engines which run at about 300 revolutions a minute. These screws are much larger in diameter than the draft of the ship, and revolve each in a special tunnel designed to secure that they always work in solid water. Access to them is gained by manholes on the main deck, and it is stated that only 20 minutes are required to remove a propeller and put another in its place.

Steam is supplied by a pair of Yarrow water-tube boilers, and the forced draft which is provided for, though not necessary for the maintenance of full speed, will be useful when the wood fuel available is green or of poor quality. The guns, which

consist of two 6-pounder q. f. and six .303 Maxims, are mounted on an upper or battery deck which extends about half the length of the ship, and being completely housed in, provides spacious quarters for Europeans; its bulwarks, like the sides of the vessel in way of the machinery and the cabin accommodation for the officers on the main deck, are protected by Cammell chrome steel of such thickness as to be proof against rifle fire, point blank, at close quarters. Aft on the main deck there is accommodation for the native crew and also a special sick-bay. The ship is fitted with no fewer than four rudders, all controlled by the usual steam and hand gear. These give extraordinary command over her steering; indeed, it is possible to make her describe a complete circle in little more than her own length—*The Times*, London, June 24.

BRITISH GUNBOAT, TEAL.

DISCUSSION.

CAPTAIN F. E. CHADWICK'S LETTER. See No. 98.

Lieut.-Commander C. N. ATWATER, U. S. N.—Captain Chadwick's views, as expressed in his timely letter, bring before the service a question of very great importance. Another important question, as to whether we shall train apprentices or landsmen, is not asked, and cannot, perhaps, be pertinently discussed in this connection; but I desire to preface what I have to say by endorsing Captain Chadwick's views concerning the training of apprentices.

The remarkable physical development which takes place among the lads on a sailing training ship in the short space of a summer or a winter cruise seems to me without a parallel in other educational institutions, afloat or ashore. This development in size and weight, in strength and activity, has recurred under my observation on successive foreign cruises, and I am convinced that it need never fail to recur if the cruise is a foreign one and if not less than half the time be spent actually at sea.

I emphasize the point that the cruise should be foreign because, of ten sailing training cruises I have made, the only two which failed to secure excellent results were along our own coast. In these two cruises there were constant restlessness and frequent desertion. The boys are always unsettled or seasick or homesick at first, and if they are in home ports they are apt to get away. If they are in foreign ports they are attracted by their novel surroundings and gradually become reconciled to the life they are leading on shipboard. The present excellent barrack training ashore followed by a foreign cruise with long periods at sea minimizes desertion and makes it possible to keep the boys interested until they are given leave before being transferred to general service.

As some officers are opposed to training apprentices in sailing ships on the ground of waste of time, I wish to give it as my belief that only four months are absolutely necessary to secure the results that advocates of sailing training ships hope to obtain. A ship sailing for the English channel in June is ready to transfer her apprentices on arrival at Hampton Roads on the 1st of November; one starting on January 1st for the West Indies has hers ready to transfer at Hampton Roads early in May. This leaves two months in which to reach a navy yard, attend to necessary repairs, lay in stores and proceed to Newport for the next lot of boys. This schedule permits of two cruises annually, and any deviation from it results in the loss of a class; the time allowed is barely sufficient for training and for refitting. It has the fewest possible drawbacks as to seasons and weather. It is a regular plan which makes it possible to keep the boys interested until they are transferred.

Other than physical benefits to the apprentices are, of course, less strikingly apparent; but it seems to be the general opinion of officers who have served in sailing training ships that the boys are rendered

alert and active, mentally as well as physically, that the life makes them courageous and quick-witted in emergencies and develops self-respect and manliness.

The preliminary training at the station now leaves little to be desired. There are progressively fewer boys each year in the drafts who are lacking in physique, capacity or ambition, or who are incorrigibly bad. The average draft is now a well-disciplined and tractable body of clean, decent young Americans who develop rapidly into very respectable seamen and excellent marksmen. Our warrant and petty officers who are ex-apprentices are the best argument for a continuance of the present training in sailing ships.

It is my earnest conviction that Captain Chadwick is wise in advocating sailing training ships and in maintaining that equally good results cannot be obtained by using vessels with steam power. Boys must be kept interested and occupied while they are being saturated with salt water, and they are less likely to be aware of the pickling process on a sailing ship than on a steamer, where equal results can only be obtained at a greater expenditure of both time and money.

Discussion by Lieutenant M. Wyt, Dutch Navy, of lecture by Lieutenant L. H. Chandler, U. S. N., on "Torpedo Operations in Naval Warfare." This discussion accompanied a translation of the above lecture by Lieutenant Wyt which appeared in the *Marineblad*, a Dutch naval magazine, printed at Helder, Holland.

In commencing his translation, Lieutenant Wyt says: "On August 6 1901, Lieutenant L. H. Chandler, U. S. N., delivered a lecture on 'Torpedo Operations in Naval Warfare' before the U. S. Naval War College at Newport, R. I. As a matter of fact the lecture must be understood by the readers of the *Marineblad* as applying to conditions existing in the United States, and it must be born in mind that everything that is true for the other side of the ocean is not always necessarily applicable to the Dutch Navy."

In concluding his translation, Lieutenant Wyt sums up as follows:

"The question of the adjustable gyroscope has also been under consideration by the Dutch commission charged with the regulation of the torpedo service, and it is regretted that, owing to its confidential nature, any discussion of it must be omitted.

"Mr. Chandler's lecture seems to me unusually interesting because he discusses the most modern improvements of the torpedo, and our war ships and torpedo vessels are fitted with weapons of the types discussed in the lecture. The diagrams show that the American Morris is very similar to our Scylla and Hydra, and I judge that our Xa, Xc and XI torpedoes are very similar to the American Whitehead, 5 metre, Mark I.

"In spite of the similarity of outfits, I suppose the Dutch navy must consider the question from a Dutch point of view, and from that point of view a section of seven boats is too large, even had we the necessary boats at our disposal. The narrow passages between the Dutch banks would not permit of such a gathering of boats, as such a large section would be unable to disperse sufficiently before coming under the guns of the enemy's ships on that account.

"It also seems to me to be a great pity to launch twenty-one torpedoes at the same moment. If the distance, speed, etc., of the antagonist have been correctly estimated, then several torpedoes will hit the target, but if there has been some mistake, then the whole section is put out of action in a moment without accomplishing anything. I prefer the system in our navy, where the torpedoes are launched at certain intervals.

"A great advantage of the adjustable gyroscope seems to me to be that, while using above water tubes, it is possible to run all of the torpedoes directly ahead. When launching the two bow torpedoes in that way, a danger zone is obtained of sufficient width to neutralize errors in judgment in pointing. This right-ahead fire seems to me the simplest to deliver, especially when it is hard to judge bearings, distances and speeds at night and under search lights and gun fire. In that case I suppose the ahead fire will give the best chance of success. I therefore believe that the Hydra and Scylla would be improved were they fitted with the adjustable gyroscope.

"I believe that the gun will always be the deciding factor in every naval engagement, and that the torpedo and ram can only come into play secondarily for a large ship. I am of the opinion that every commander will be obliged to manoeuvre mainly to make his gun fire tell, and that the ram and torpedo must wait for their opportunity during the melee at the end of the battle.

"I cannot understand how Mr. Chandler can reset his adjustable gyroscope in a very short time, especially with the submerged tube. It is clear that he intends to put his torpedoes in the tubes before the action opens, and that is the only proper way. The quick changes during the different phases of the fight would make it very unwise to put one of your torpedoes out of action for a short time to reset it, especially when you are driven to bay by a powerful enemy. Only the attacking party will have the time to spare five or ten minutes for resetting the gyroscope, and I suppose five or ten minutes would be a minimum for a submerged tube.

"I sincerely hope that Mr. Chandler's very interesting paper has shown to the readers of the *Marineblad* that in the American Navy there is a strong inclination to secure a prominent place for the fleet."

PROFESSIONAL NOTES.

Prepared by Lieutenant L. S. VAN DUZER, U. S. Navy.

For convenience of reference these notes are arranged as follows:

A. Notes on ships of war, budgets, and personnel, the notes appearing under the head of the naval power to which they refer. Alphabetical arrangement is followed.

B. Miscellaneous Notes on Armor, Ordnance, Explosives, Torpedoes, etc. The arrangement is aphabetical and the principal heads are:

1. Ammunition.
2. Armor.
3. Boats.
4. Boilers.
5. Canals, Harbors, and Waterways.
6. Coaling Ship.
7. Coast Defense.
8. Communications.
9. Construction.
10. Docks.
11. Electricity.
12. Engines.
13. Fortifications.
14. Fuel.
15. Gunpowder and Explosives.
16. Guns.
17. Guns: Firing.
18. Guns: Mounts.
19. Instruments Used in Action, etc.
20. Machinery (auxiliary engines), etc.
21. Operations (war or manoeuvers).
22. Propulsion.
23. Small Arms.
24. Strategy and Tactics.
25. Torpedoes.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

AUSTRIA.

AUSTRIAN NAVAL BUDGET FOR 1901-1902.—The Austrian naval budget for 1901-1902 was approved May 23, 1901. The total amount appropriated is 46,690,820 crowns ($9,478,236.46; 1 crown = $0.203), an increase of 3,200,000 crowns on the appropriations for 1900-1901. The ordinary estimates amount to 30,803,200 crowns and the extraordinary to 15,887,620 crowns. The principal increases are 1,250,000 crowns for new construction, 200,000 crowns for arms, and 200,000 crowns for maintenance, transportation, and exercise of the fleet. Some of the principal items are as follows:

	Sum appropriated, crowns.	To be appropriated in future budgets, crowns.
In the ordinary estimates:		
For the torpedo cruiser Szigetvar, 4th instalment	200,000	61,810
" ram cruiser E (Ersatz Radetzky), 3d instalment	2,800,000	6,306,000
" battleship A (Ersatz Laudon), 2d instalment	2,600,000	13,600,000
" " B (Ersatz Drache), 1st instalment	500,000	16,900,000
In the extraordinary estimates:		
For the coast-guard battleship Habsburg, 5th instalment.	600,000	60,000
" " " Arpad, 4th instalment	3,800,000	885,000
" " " Babenberg, 3d instalment.	3,800,000	6,275,480
" two monitors for the Danube and five vedette boats (total estimated cost 3,400,000 crowns), 1st instalm't.	400,000	3,000,000
For a steel floating dock	100,000	4,400,000
For the construction of an ammunition store-house, repairs, etc.	128,200	.....

From the budget statement it appears that the new construction to be undertaken during the year consists of a new battleship, two monitors for the Danube, and five vedette boats.

ARPAD: LAUNCH.—The *Reichswehr* states that the battleship Arpad (Battleship II, fully described in PROCEEDINGS *No. 97*, page 151), will be launched September 11, 1901.

FRANCE.

ESTIMATES FOR 1902.—The projected budget (*projet de loi*) for 1902 as submitted to the French Chamber and reported to that body by M. Lockroy, amounts to 312,097,951 francs ($60,234,904.54; 1 franc = $0.193), which is 15,594,579 francs less than the budget for this year; but the cost of the colonial army, about 27 million francs, has been transferred to the budget of the ministry of war, so that in reality there is an increase of about 11.5 millions. The budget makes provision for continuing the program already laid down (see PROCEEDINGS *No. 97*, page 154).

VESSELS TO BE COMMENCED 1901-1905.—The building program (see PROCEEDINGS No. 97, page 154), as developed by the ministry of Marine calls for the laying down of new ships as follows:

At Cherbourg arsenal: In 1901, the submarine boats Naïade, Protée, Lynx, Ludion, Q_{25}, and three others. In 1902, the armored cruiser C_{14}. In 1904, ten submarine boats, Q_{52} to Q_{60}.

At Brest arsenal: In 1901, the battleship République. In 1902, the battleship A_{12}.

At Rochefort arsenal: In 1901, the torpedo boat destroyers Francisque and Sabre; submarine boats Loutre, Castor, Phoque, Otarie, Méduse, Oursin, and Q_{36}. In 1902, the torpedo boat destroyers M_{32} and M_{33}. In 1903, six torpedo boat destroyers, M_{34} to M_{39}. In 1904, eight submarine boats, Q_{43} to Q_{50}.

At Toulon arsenal: In 1901, armored cruiser Victor Hugo; submarine boats Perle, Esturgeon, Bonite, Souffleur, Dorade, Thon, Grondin, Anguille, Alose, Truite, Q_{27}. In 1903, five submarine boats, Q_{38} to Q_{42}. In 1904, eight submarine boats, Q_{61} to Q_{68}.

At Saïgon arsenal: In 1901, torpedo boat 277. In 1902, P_{112}. In 1903 and 1904, torpedo boats P_{138} and P_{177}.

At private building yards: In 1901, the battleship Patrie; torpedo boat destroyers Darde and Baliste at Rouen; Mousqueton and Arc at Chalons; Pistolet and Belier at Nantes; Catapulte and Bombarde at Havre; torpedo boats 266, 267, 268 at Nantes; 269, 270 at Havre; 271, 272 at Chalons; 273, 274, 275, 276 at Bordeaux. In 1902, battleships A_{11}, A_{13}, A_{14}; armored cruiser C_{15}; fifteen torpedo boats P_{97} to P_{111}. In 1903, twenty-five torpedo boats P_{113} to P_{137}. In 1904, thirty-eight torpedo boats P_{139} to P_{176}. In 1905, sixty-two torpedo boats P_{178} to P_{239}.—*Rivista Marittima.*

Work on the new ships is proceeding slowly. Neither the République nor the Patrie have been commenced. The keel of the former will not be laid until after the launch of the Léon Gambetta, which is only just begun. When the keel of the Patrie will be laid is uncertain.

PROMOTION OF PETTY OFFICERS TO THE GRADE OF ENSIGN.—The French navy, like our own, is very short of officers. The personnel law of June 10, 1896, admitted chief petty officers, whose terms of service and professional knowledge conformed to certain requirements, to a school of instruction from which they were appointed ensigns. A modification

has recently been made by which certain petty officers of the next lower grade (to chief petty officers), whose services and acquirements are satisfactory, will also be eligible to appointment to the school of instruction.

FRENCH MANŒUVRES.—The French manœuvres have been attracting a good deal of attention during the week, and some of the incidents have been made known by the daily press. We cannot describe the operations at length, but certain points are deserving of special remark. It is, of course, plain that the operations were intended to represent the conditions of war with this country. The B squadron under command of Vice-Admiral Ménard, comprising the Masséna, Carnot, Amiral Baudin, Formidable, Hoche, and Courbet, with a light squadron of five vessels under Rear-Admiral Gourdon, was the French Northern Squadron from Brest, and was intended to represent our Channel Squadron seeking to effect a junction with the Mediterranean Squadron. This last in the French manœuvres, was represented by the C Squadron, under Rear-Admiral de la Noë, comprising the Charles Martel, Jauréguiberry, Lavoisier and Dunois, belonging to the French Mediterranean forces. The French squadron which was to attempt to prevent the junction of these forces was under command of Vice-Admiral de Maigret, and comprised the Gaulois, her two sisters, and the Brennus, with a light squadron under Rear-Admiral Caillard, comprising seven vessels. There was another squadron engaged, which represented the French Northern Squadron coming to the help of the French Mediterranean forces. This was under command of Rear-Admiral Mallarmé, and included the Bouvines, Tréhouart, and La Hire, with the collier Japon.

The system adopted was to give all these vessels a numerical value, and the squadrons were so accounted, that under Admiral de Maigret was worth 1,250, and that which was coming to join him 305. The force under Admiral Ménard, which represented our Channel Squadron, had a total value of 1,750, while that which stood in the place of our Mediterranean squadron was given a figure of 425. It is, of course, evident that these estimates were conventional and did not adequately represent, or endeavor to represent, the actual value of the forces that would have been actually engaged. It is possible that the French Admiralty was just as desirous to take account of a quarrel with the Triple Alliance, in which a German squadron might have come south to join hands with Italians, and perhaps Austrians, while the Russians were coming to the aid of their allies. One significant point appears to have been that Admiral Gervais, who was in supreme command, with his flag in the Bouvet, was empowered to join with either side in case it should appear that the manœuvres were likely to end without giving the lesson that had been expected.

In the result, those forces which represented our Channel and Mediterranean squadrons succeeded in effcting a junction, though not without sustaining some losses, and some of them reached Ajaccio, which may be taken to represent Malta, where an attempt to block them was made. If Admiral de Maigret had been able to defeat his two enemies severally before their junction, he would have triumphed, but, as soon as they were united, unless they had sustained severe losses, he would be in an inferior position. A high French authority is said to have asserted that the causes of his partial failure were well known, and could not recur in the case of actual war. The period of hostilities concluded on Tues-

day, and on Thursday morning the combined force entered Toulon, where a test was to be made of the capabilities of the port for coaling, provisioning, and repairing so large a fleet at short notice. Within an hour of the arrival 4,250 tons of coal had been taken on board the ships. The national fête will be celebrated, and the fleet will then engage in further evolutions.—*Army & Navy Gazette*, July 13.

SULLY LAUNCH.—The armored cruiser Sully, 10,014 tons, was launched at the yard of the Forges et Chantiers de la Mediterranée, La Seyne (near Toulon), on June 4. She is a sister ship in all respects to the Condé, fully described in PROCEEDINGS, *No. 97*, page 157.

DUPETIT THOUARS: LAUNCH DESCRIPTION.—This armored cruiser of the Montcalm class was launched at Mourillon arsenal, Toulon, July 5, 1901. She differs from her sisters in having Belleville boilers—the Gueydon having 28 Niclausse, and the Montcalm 4 Normand boilers and 8 of the double Normand-Sigaudy type. The hull is of steel without sheathing and specially subdivided in the vicinity of the water line. The free board is high at the bow and the upper deck extends from the stem to within 15 or 20 feet of the stern. As the decks have considerable sheer the stern is not very high above water. There is a military mast forward carrying a fighting top and a searchlight platform. The mainmast is intended chiefly for signalling but carries a small top placed rather low. The electric plant consists of four 400-ampère, 82-volt dynamos, driven by vertical compound engines at a speed of 350 revolutions. For interior lighting there are about 500 lamps. One searchlight is located on a platform at the head of the military mast, one on a platform low down on the main mast, and four are on the main deck—two forward and two aft—mounted on traveling railways, and rig in and out. Eighteen boats are carried. The full complement as a flagship is 610. The estimated cost of the ship complete is $3,961,665, of which $436,206 is for guns and $35,604 for torpedo armament. The principal details are:

Armament.—Two 7.6-inch guns in turrets on the upper deck, one forward, one aft, with arc of fire of 270 degrees. Eight 6.48-inch guns in armored sponsons on the main deck, four each side. The two forward guns can fire directly ahead and the two after ones directly astern. Each gun is enclosed in a casemate and each has a separate ammunition hoist actuated by electricity or by hand. Four 3.9-inch guns on the upper deck protected by shields: two over forward 6.48-inch guns and two nearly over the after 6.48-inch guns: each with a separate ammunition hoist. Sixteen 3-pounders: four in the military top; six on the upper deck and bridges; two on the main deck; and four on the berth deck. Six 1-pounders on the bridges and on the main deck aft. The 3-pounder and 1-pounder guns are served by three ammunition hoists, one in the military mast, one forward, and one aft. There are said to be four torpedo tubes, two of which are submerged.

Protection.—At the water line the main armor belt extends from the stem to within 13 feet of the stern, where a transverse bulkhead unites the ends. This belt rises 2.36 feet above, and descends 4.43 feet below water, except at the after end when the depth below water is only 2.36 feet. Its maximum thickness is 5.9 inches, decreasing to 3.54 inches forward and to 3.15 inches aft. Above the main belt a thinner belt extends over the same length and rises to the level of the upper armored deck, thus protecting the space between the two protective decks (the "tranche cellulaire"); its thickness is 3.74 inches amidships, decreasing

to 3.35 inches forward and 2.95 inches aft. There is still another belt above this which extends aft from the stem for a length of 141 feet to a point abreast the forward smokepipe and rises to the level of the main deck. It is 2.24 inches thick at the lower edge and 1.58 inches at the upper edge. The thwartship bulkhead forward of the forward casemates has armor 4.72 inches thick, and that abaft the after casemates is 3.94 inches thick. The transverse bulkhead which joins the after ends of the two side armor belts is 3.31 inches thick at the lower edge and 1.58 inches at the upper. The bulkheads at the ends of the casemates extend from the main deck to the upper deck and protect the 6.48-inch guns from raking fire; the bulkhead at the after ends of the belt extends downward from the main deck to the protective deck. The lower protective deck is of the usual turtle-back form and its slope descends to meet the lower edge of the main belt. It is 1.2 inches thick on the flat and 1.2 to 2.2 inches on the slopes. The upper protective deck is flat and rests on the upper belt. It is composed of one layer 0.4 inch thick except between the turrets, where it is composed of two layers of a total thickness of 0.63 inch. The conning tower on the forward bridge deck has 6.3-inch armor and a communication tube 4.7 inches thick.

Motive Power.—Triple-screw, vertical, 3-cylinder, triple-expansion engines, designed to develop 19,600 I. H. P. at 135 revolutions and give a speed of 21 knots. The engines are placed side by side in the same transverse space, but are separated by longitudinal watertight bulkheads. Steam is furnished by 28 Belleville boilers in four boiler compartments—two forward of and two abaft the engines and separated from each other and from the engine compartments by transverse bulkheads. The normal coal supply is 1020 tons; total capacity, 1600 tons. Provision is also made for carrying petroleum fuel in four cisterns—two forward, two aft—each holding 20 tons.

Dimensions.—Length, 459.2 feet; beam, 63.96 feet; draught, 24.6 feet; displacement, 9517 tons (metric).

IÉNA: FINAL TRIALS.—The battleship Iéna has completed her trials. The full power trial took place July 16 with the following results: I. H. P., 16,500; revolutions, 126; speed, 18.2 knots; coal burned per square meter of grate area, 135 kilograms; coal burned per I. H. P. per hour, 0.779 kilogram. The machinery worked well in every respect. On July 9, preceding, she had a preliminary 6-hour trial with 20 boilers. The results were: I. H. P., 9000; speed, 16 knots, easily maintained.

TAGE: TRIALS.—The protected cruiser Tage, 7345 tons, has completed her trials satisfactorily. She was launched in 1886 and has recently been refitted, receiving new engines and boilers. Her first trials after refitting were unsatisfactory owing to accidents to the machinery.

DAVOUT: TRIALS.—The protected cruiser Davout has also been extensively repaired, receiving new machinery and Niclausse boilers. The trials, after completion of the repairs, are reported as satisfactory.

LIBELLULE: BUILDING.—The small torpedo boat Libellule is building at the Graville yard of the Forges et Chantiers de la Mediterranée, Havre. The dimensions are: Length, 118.1 feet; beam, 10.8 feet; displacement, 40 tons. The motive power consists of a turbine engine driving a single shaft carrying three screws. The boiler is of a new type designed by M. Rénard. The machinery is of 900 I. H. P. The screws project well astern and the rudder is forward of them and above the shaft. There are two smokepipes, oval in shape and side by side. Pe-

troleum fuel will be used either wholly or in part. The speed is expected to be about 35 knots. A single torpedo tube is carried on the stern.

BOMBARDE, CATAPULTE: ORDERED.—These torpedo-boat destroyers, of the same general type as the Arquebuse, Arbalète. etc., have been ordered of Messrs. A. Normand et Cie., Havre.

TORPEDO BOATS ORDERED.—Nos. 267 and 270 have been ordered of Messrs. A. Normand et Cie., Havre; Nos. 273 and 274, of Dyle & Bacalan, Bordeaux (contract time, 18 and 19 months); Nos. 275 and 276, of the Ateliers de la Gironde, Bordeaux (contract time, 16 and 18 months).

RAPIÈRE: LAUNCH.—The torpedo-boat destroyer Rapière, 303 tons, was launched at the arsenal, Rochefort, July 16. She is a sister boat in all respects to the Pertuisane and Escopette described in PROCEEDINGS *No. 97*, page 157.

TYPHON: LAUNCH, DESCRIPTION.—This torpedo boat was launched at the Graville yard of the Société des Forges et Chantiers de la Méditerranée, Havre, June 15. She is a sister to the Siroco, Mistral, and Simoun, but possibly differs from the Siroco and Mistral slightly in dimensions. The particulars of the Typhon and Simoun are: Length, 147.6 feet; beam, 16.7 feet; displacement, 185 tons. The armament consists of two torpedo tubes and two 3-pounders. The sides abreast the machinery spaces and the sloping parts of the deck over them are armored with nickel-steel plates 0.95 inch in thickness; the flat parts of the deck having plates of about half this thickness. The engines are twin-screw, designed to develop 4200 I. H. P. and give a speed of 26 knots.

TRAMONTANE: LAUNCH.—This torpedo boat was launched at Bordeaux (Ateliers de la Gironde?), May 21. She is a sister boat to the Borée which is undergoing trials. The dimensions are: Length, 147.6 feet; beam, 15.68 feet; displacement, 161 tons. The armament consists of two torpedo tubes and two 3-pounders. The engines are twin-screw, designed to develop 4400 I. H. P. and give a speed of 29 to 30 knots. Like the Typhon and others of her class, the Tramontane and Borée have thick nickel-steel plating over the boiler and engine rooms.

SIROCO: TRIALS.—The torpedo boat Siroco, 180 tons (see PROCEEDINGS *No. 98*, page 386), has completed her trials. She begun her progressive trials on June 24 and all went well up to 25 knots; then a crank pin became heated and the trial was stopped. On July 6, the state of the sea and a slight accident combined to interrupt the trial. But on July 11 the trials were completed with success. The speed on the measured base was 28.727 knots with 355 revolutions. The contract speed was 26 knots.

MISTRAL: TRIAL.—The Mistral, a sister boat in all respects to the Siroco, also completed her trials on July 11. The results were: Revolutions, 351; speed, 28.23 knots.

NEW SUBMARINE BOATS: GENERAL CHARACTERISTICS.—The Cherbourg correspondent of the *Yacht* says: "We learn that the new submarine boats already commenced, or to be commenced this year, will have a double motive power like the submergible boats; that is to say, a vapor, or gas engine, and electric accumulators. They will not be, however, submergible boats of the Narval and Sirène type, but true submarines in the proper sense of the word; only they will have a motor for propulsion when at the surface and for recharging the accumulators—the

latter being used only when submerged. In a word, they will realize up to a certain point the autonomous type of submarine boat. They will have a radius of action a little more extended than that of the purely submarine boat and will plunge more quickly than the Narval and Sirène, which are obliged to fill the ballast tanks between the hulls—a long operation as we know. The newer submarines, thanks to their small dimensions, will be easy to manoeuver. But one must not forget that, like all submarines, they are, above all, fair weather weapons, and particularly weapons for use during daylight. At night, in a calm—or nearly calm—sea, they can still operate; but, unlike the ordinary torpedo boat, they are not an arm whose most effective work is night attack."

In a later issue of the *Yacht* (July 6) the same correspondent says: "The submarine boat Morse will very soon make a descent and remain submerged for sixteen hours, in the course of which a tablet prepared by Dr. Gibrat will be tested. The tablet will be applied to the lips and nostrils in order to prevent the inhalation of toxic gases with which the air of submarine boats is charged. We learn that a submarine boat of a new type designed by M. Romazotti, the designer of the Morse, will be built at Cherbourg. It will be an experimental boat, costing 499,400 francs. and will differ notably from the other little vessels of this sort which are to be built in our port. These last will cost 365,400 francs each and there will be seven of them. They will have a displacement of 68 tons only, a length of 23.5 meters (77.1 feet), and a beam of 2.26 meters (7.4 feet). The only motive power will be electricity supplied by accumulators. Four of them have already been named—the Naïade, Protée, Lynx, Ludion."

TRITON: LAUNCH.—The submergible boat Triton, of the Narval type, and a sister to the Sirène, Silure, and Espadon, was launched at the arsenal, Cherbourg, July 13, 1901. For description, see PROCEEDINGS *No. 98*, page 387.

NARVAL: SEA TRIALS.—The submergible boat Narval has recently completed a 40-hour sea trial. In an article by M. Marc Landry in the *Moniteur de la Flotte*, comparing the Holland and the Narval, the trial is thus described:

"In obedience to orders of the Minister of Marine the Narval was subjected to a trial of endurance of forty hours. It left Cherbourg at one o'clock on the afternoon of May 22, with an ample supply of provisions, escorted by the seagoing torpedo boat Zouave, and was to return to Cherbourg on the morning of May 24. The sea being very rough on account of a strong wind from the northeast, the Narval ran into St. Malo at five o'clock on the morning of the 24th. This was the only variation from the established program.

"Our first submergible boat has thus navigated for forty hours without a single stop, covering a distance of 260 miles at a mean speed of 6.5 knots in a heavy sea. During this trip it made a plunge of several hours and twice recharged its accumulators while under way.

"On the 25th of May, the Narval left St. Malo without having taken on more provisions, petroleum, or stores. It proceeded directly to Cherbourg, and, on arriving, fired one of the four torpedoes carried. This firing showed that the adjustments of torpedoes remaining in the firing tube for five hours is not in the least disturbed.

"In order to be entirely truthful, it is proper to add that while the Narval had not a single accident during the forty hours trial, it had,

on the return from St. Malo, an accident to the pump. In order not to delay the arrival, the Narval was towed by the Zouave for three hours. Off La Hague the tow line was cast off and the boat proceeded to Cherbourg unassisted. This was the only incident of the trip."

The conditions under which this test was made were favorable toward bringing out the Narval's strong points. She is doubtless a success as a surface-cruising boat and is habitable when in this condition. Her great—one may say fatal—defect is the slowness of her submergence. If she be ever sighted by an enemy's cruiser, battleship, or desroyer, her doom is sealed. Under the most favorable conditions it takes fifteen minutes for submergence—and longer if attempting to go ahead. A destroyer can run six or seven miles in fifteen minutes and a cruiser or battleship at least four miles. The Narval could, therefore, never approach within striking distance of an enemy without reasonable certainty of being destroyed, unless she operates as a submarine.

NARVAL: EFFECT ON CREW OF 12 HOURS SUBMERGENCE.—"Considerable attention has been drawn to the effect produced upon the crew of the Narval during prolonged submersion. It was, therefore, determined to make a trial in which the boat should remain for twelve hours under water. This was arranged owing to disquieting facts noticed during recent experiments, it being found that the crew experienced what are described as grave sensations of fatigue and uneasiness. Up to that time the trials had been of comparatively brief duration, and no one doubted that longer periods would cause no trouble. A trial has lately been made, Dr. Gibrat, a medical officer of the French Navy, being in the boat. It is said to have been proved conclusively that the strain was far too much for the men. The close confinement and the want of fresh air produced nausea and exhaustion, and the men are said to have been completely unnerved. The reports will, doubtless, be carefully investigated. They have probably been exaggerated. Otherwise the boat has given satisfactory results. In the recent trials she covered 260 miles between Cherbourg and St. Malo in forty hours, and 90 miles on the return, making in all 350 miles, of which she was towed thirty under water, and the accumulators were charged twice during surface steaming. On arriving at Cherbourg the petroleum was not exhausted, and firing the torpedoes showed that the tubes had received no damage.—*Army and Navy Gazette.*

MORSE: FAILURE OF ATTACK ON THE COCYTE.—During his inspection of the Defense Mobile of the coasts, Admiral Fournier directed the Morse to make an attempt to torpedo the Cocyte using, of course, a torpedo with exercise head. The Morse was able easily to approach the Cocyte without being seen; but a northeast breeze rendered the sea lumpy and she was unable to launch her torpedo. This confirms what we have previously said: That submarine boats can be sure of succeeding in their attack only when the sea is calm or nearly so. In circumstances less favorable, they may be successful but they cannot count on it in their present state of development."—Cherbourg correspondent of *Le Yacht.*

GUSTAVE ZÉDÉ: RECENT TRIALS.—If the particulars given of the operations of the Gustave Zédé were credited, she seemed to have achieved success. According to the correspondent of the *Journal* she left Toulon under the command of Lieut. Jobard, convoyed by the Utile, and arrived off Ajaccio at six o'clock in the morning, the tug having kept out of

sight. The Zédé was then submerged, except for the periscope, and to some extent it was possible to discern the positions of the ship at anchor in the harbor. Two hours later the cruisers and torpedo boats came out at full speed, and the Zédé, which was lying on the surface at the time, had to plunge to escape observation. An attack was then made upon the Charles Martel, which was said to have been torpedoed. The Zédé afterwards returned to Toulon. We do not know the real conditions of this attack, and the suggestion may be hazarded that the battleship was lying in position for the submarine to practice upon. If this be so the value of the trial will be considerably reduced. It would not, at any rate, be wise to attach at the present time too much importance to it. The correspondent of the *Temps* said that after discharging its torpedo, the Zédé had to rise, and was under fire at short range, which would inevitably have destroyed her. She sought to plunge, but almost ran upon the ram of the Jauréguiberry, and would have been cut in two but for the clever handling of the battleship. In regard to the question of habitability, it is confessed that there were difficulties, but the *Temps* believes that the crew came out into the open air from time to time while the vessel was floating on the surface."—*Army & Navy Gazette*, July 13.

Concerning this attempt the *Engineer* (London) says: "Very pretty are the stories now running round concerning the Gustave Zédé, the lieutenant in which should become a very Lord Charles Beresford. Very pretty, but some of them are imaginary, beyond doubt, while two little facts are mostly ignored. In the first place, the Jauréguiberry had to turn to avoid ramming the precious submarine; in the second, the descriptions, if at all correct, indicate that the submarine would have annihilated herself in the attack. Finally, there is little reason to suppose that the torpedo boats could not have got the fleet just as easily, and without loss, the night before. Or they might have watched, followed, and attacked the next night. The superfluity of the submarine is the point the enthusiasts so forget."

GERMANY.

BUDGET FOR 1901.—The Budget for 1901 amounts to 196,416,572 marks ($46,747,144.14; 1 mark = $0.238), a considerable increase on the budget of 1900, which only amounted to 152,741,132 marks ($36,352,389.42).

ORDINARY PERMANENT EXPENDITURE	Marks.
Ministry of Marine and Naval Cabinet	1,295,620
Naval General Staff	122,385
Observatories, coast watch-towers, &c.	318,995
Station superintendence	358,625
Law department	107,580
Chaplain's department and garrison schools	84,206
Pay of officers and men	17,940,239
Maintenance of the fleet in commission	19,113,373
Allowances for officers and men	1,173,700
Clothing	319,791
Garrison administration and service	2,490,835
Allowance for quarters, etc.	1,359,109
Medical department	1,336,452
Traveling, transport, and freight charges	2,485,183
Training establishments	316,384

	Marks.
Maintenance of the fleet, dockyards, &c.	21,621,949
Ordnance and fortifications	7,268,505
Department of accountant-general	553,371
Pilotage and surveying	524,874
Miscellaneous expenses	992,120
Total of Naval Administration	79,783,296
Additional for Administration of Kiau Chau protectorate	48,126
Total of ordinary permanent estimates	79,831,422

SPECIAL ORDINARY ESTIMATES.

A. Shipbuilding.

For the construction of the first class battleship Kaiser Barbarossa (A), 4th and last instalment	2,750,000
For the Kaiser Karl der Grosse (B), 4th and last instalment.	2,058,000
For the armored cruiser Prince Heinrich (A), 4th and last instalment	3,375,000
For the 1st class battleship Wittelsbach (C), 3d instalment.	3,600,000
For the 1st class battleship Wettin (D), 3d instalment	6,000,000
For the 1st class battleship Zähringen (E), 3d instalment	6,000,000
For the 3d class cruiser Thetis (C), 3d and last instalment	1,140,000
For the 3d class cruiser Ariadne (D), 3d and last instalment	1,140,000
For the 1st class battleship F, 2d instalment	6,500,000
For the 1st class battleship G, 2d instalment	6,500,000
For the armored cruiser Prince Adalbert (B), 2d instalment.	6,000,000
For the 3d class cruiser Medusa (E), 2d and last instalment.	2,640,000
For the 3d class cruiser Amazone, 2d and last instalment	2,640,000
For the gunboat A, 2d and last instalment	1,000,000
For the 1st class battleship H, 1st instalment	3,000,000
For the 1st class battleship I, 1st instalment	3,000,000
For the armored cruiser to replace the Konig Wilhelm, 1st instalment	3,400,000
For the 3d class cruiser G, 1st instalment	1,300,000
For the 3d class cruiser H, 1st instalment	1,300,000
For the 3d class cruiser I, 1st instalment	1,300,000
For reconstruction of ships of Siegfried class	4,500,000
For a torpedo boat division, 1st instalment	2,400,000
For a torpedo boat division, 2d instalment	3,440,000
Total for Shipbuilding	74,983,000

B. Armament: Guns, mountings, etc.

For the battleship Kaiser Wilhelm der Grosse, 5th and last instalment	1,500,000
For the battleship Kaiser Barbarossa (A), and Kaiser Karl der Grosse (B), fourth instalment	3,800,000
For the armored cruiser Prinz Heinrich, 4th and last instalment	1,200,000
For the battleships Wittelsbach (C), Wettin (D), and Zähringen (E), 3d instalment	3,900,000
For the third class cruisers Thetis (C), and Ariadne (D), 3d and last instalment	400,000

	Marks.
For the battleships F, and G, 2d instalment	2,000,000
For the armored cruiser Prinz Adalbert (B), 2d instalment	2,100,000
For the third class criusers Medusa (E), and Amazone (F), 2d instalment	500,000
For the gunboat A, 2d and last instalment	290,000
For a torpedo boat division, 2d and last instalment	213,000
For the battleships H and I, 1st instalment	2,800,000
For the armored cruiser Ersatz Konig Wilhelm, 1st instalment	1,300,000
For the third class cruisers G, H, and I, 1st instalment	1,200,000
For a torpedo boat division, 1st instalment	210,000
For the improvement of the battery of ships of the Siegfried class, 1st instalment	500,000
Total for Guns, etc.	21,913,000
C. Torpedo Armament.	
For the battleships Kaiser Barbarossa (A), and Kaiser Karl der Grosse (B), 3d and last instalment	520,000
For the third class cruisers Thetis (C), and Ariadne (D), 3d and last instalment	220,000
For the battleships Wittelsbach (C), Wettin (D), and Zähringen (E), 2d instalment	900,000
For the third class cruisers Medussa (E), and Amazone (F), 2d instalment	280,000
For a torpedo boat division, 2d and last instalment	300,000
For the battleships F and G, 1st instalment	300,000
For the armored cruiser Prinz Adalbert, 1st instalment	240,000
For the armored cruiser Ersatz König Wilhelm, 1st instalment	100,000
For the third class cruisers G, H, and I, 1st instalment	120,000
For a torpedo boat division, 1st instalment	240,000
For the alteration of the torpedo armament of ships of the Siegfried class, 1st instalment	470,000
Total for torpedo armament	3,690,000
OTHER ITEMS	
Works in Navy Yards, etc.	14,699,150
Fortification works	1,300,000
RECAPITULATION.	
Ordinary permanent estimates	79,831,422
Shipbuilding	74,983,000
Guns, etc.	21,913,000
Torpedo armament	3,690,000
Work in Navy Yards	14,699,150
Fortification works	1,300,000
Total	196,416,572

—*Mittheilungen aus dem Gebiete des Seewesens.*

PERSONNEL.—According to the Rangliste of the German Navy, corrected to May 8, 1901, the numbers in the officers' lists are as follows, 2 admirals, 7 vice-admirals, 12 rear-admirals, 54 captains (capitäne

zur see), 22 commanders (fregatten capitäne), 86 lieutenant commanders (corvetten capitäne), 209 capitän-lieutnants first class, 324 capitän-lieutnants second class, 133 ober-lieutnants zur see, 424 lieutnants zur see and fähnriche zur see, and 211 see cadetten. Total executive officers, 1484. Officers of other corps, 539. Total of all lists, 2023. The increase for the current year includes 1 rear-admiral, 3 capitäne zur see, 9 fregatten capitäne and corvetten capitäne, 7 capitän-lieutnants of the first class and 5 of the second class, 24 ober-lieutnants zur see, 16 lieutnants zur see, 56 fähnriche zur see, and 45 See cadetten.

The Engineering branch consists of 1 chief engineer with the rank of commander, 3 senior staff engineers, 26 staff engineers, 55 engineers first class, and 86 engineers. The increase for the current year being 1 chief engineer, 4 staff engineers, 1 engineer first class, and 22 engineers. There are also 15 torpedo engineers attached to the dockyards and torpedo depots.

The Medical corps consists of 1 medical director-general (with the rank of rear-admiral), 2 inspectors-general, 7 fleet surgeons, 24 senior staff surgeons, 62 staff surgeons, and 80 surgeons and assistant surgeons; being an increase of 2 fleet surgeons, 5 senior staff surgeons, 4 staff surgeons, and 17 surgeons and assistant surgeons.

The Pay Corps consists of 13 staff paymasters, 61 senior paymasters, and 40 paymasters.

The Marine Corps officers are 1 major general, 2 lieutenant colonels, 6 majors, 31 captains, and 97 lieutenants, an increase for the year of 1 major general, 2 lieutenant colonels, 2 majors, 12 captains, and 44 lieutenants.

The seamen division consists of 62 chief warrant Officers, 98 warrant officers, 11,940 petty officers and men, and 1300 boys—a total of 13,400, showing an increase of 2 chief warrant officers, 7 warrant officers, 891 petty officers and men, and 300 boys.

The Dockyards division consists of 218 chief warrant officers, 434 warrant officers, and 7368 petty officers and men, of whom 563 chief and warrant officers, and 5872 petty officers and men form the engine-room personnel of the fleet, and of which there is an increase of 55 chief and warrant officers, and 660 petty officers and men, with a total increase in the division of 60 chief and warrant officers, and 805 petty officers and men.

The Torpedo division consists of 195 chief and warrant officers and 2962 petty officers and men, of which 40 chief and warrant officers and 1522 petty officers and men are of the seaman class, while 155 chief and warrant officers and 1440 petty officers and men are of the engineering branch. The increase in this division consists of 15 chief and warrant officers and 323 petty officers and men.

The Seaman artillery division consists of 28 chief and warrant officers and 2267 petty officers and men, an increase of 2 warrant officers and 95 petty officers and men.

The Marine infantry consists of 196 non-commissioned officers and 1038 men, an increase of 35 non-commissioned officers.

The total strength of the navy, including all branches, stands at 2134 officers and 28,904 warrant and petty officers and men, or a total of 31,038 officers and men, as compared with 28,204 officers and men in 1900, showing an increase of 2834 over last year.—*Journal of the Royal United Service Institution* and other sources.

ENGINEERING SCHOOL.—By order of the Emperor, a naval engineering school, for the instruction of officers in the higher grades, will be opened at Kiel on October 1. A senior naval officer will be placed in charge.

ARMY OFFICERS IN THE FLEET.—It is reported that 360 officers of the German army are to be embarked on vessels of the fleet for the purpose of acquiring some knowledge of ships from direct observation. They will be divided among the ships of the squadrons during the naval manoeuvers. This is an excellent idea. No army officer without a knowledge of the general characteristics of ships and the conditions under which they operate is competent to properly conduct operations on shore against the attack of ships.

COALING STATION IN THE RED SEA.—It is stated that the German Navy Department desires to establish a coaling station in the Red Sea, and that it has endeavored to obtain the session of the little archipelago of Farsan from Turkey. The Ottoman government was not willing to accede to this proposition, but has permitted the Germans to establish a station on the little island of Kouma, near Farsan, where they have constructed some buildings, under the surveillance of a Turkish functionary, conformably to instructions from the Porte.

THE GERMAN FLEET.—The matériel of the fleet, including ships under construction, is as follows:

Twenty-nine battleships; to be increased to thirty-eight in accordance with the Navy Act of 1900. Of these there are eight first-class battleships completed and eight in various stages of construction; five third-class battleships, and eight fourth class—the latter being rated as coast-defense ships.

Twelve first-class cruisers completed and building, which are to be increased to fourteen. Of these there are three armored cruisers, only one of which, the Fürst Bismarck, is a new ship, the other two being really only third-class battleships which are twenty-seven years old. There are three armored cruisers building; the other six first-class cruisers are of the protected cruiser class and five are quite new ships.

Thirty-two small cruisers, to be increased to thirty-eight. Of these, twenty-eight are completed and four are building. Six of the completed small cruisers are new and eight others are first-class gunboats, five of which are new.

There are fourteen school and training ships and six special-service vessels. Eighteen torpedo-boat destroyers; one hundred and nine first-class torpedo boats; thirty second class; and one torpedo-depot ship.—*Journal of the Royal United Service Institution.*

BATTLESHIPS H AND I: CONTRACTS AWARDED.—The contract for the construction of battleship "H," of the new program, has been awarded to the Germania Works at Kiel; and the contract for battleship "I" to Herr F. Schichau, Dantzic. They are to be completed in 1904.

PROTECTED CRUISERS G, H, AND I: CONTRACTS AWARDED.—The contracts for these vessels have been awarded as follows: "G" and "H" to the Howaldt Company, Kiel; and "I" to the Weser Company, Bremen. The contract time is two years, so that they are to be delivered in the spring of 1903. These vessels are similar to the Amazone, 2645 tons, which is described in PROCEEDINGS *No. 96*, page 703.

ARMORED CRUISER C: CONTRACT AWARDED.—The contract for the construction of armored cruiser "C," to be built to replace the Konig Wilhelm—and temporarily styled Ersatz-Konig Wilhelm—has been

awarded to Messrs. Blohm and Voss of Hamburg. The contract time is three years. She will probably be launched in the autumn of 1902 and completed in the spring of 1904.

WETTIN, ZÄHRINGEN: LAUNCH.—These two battleships, formerly known as "D" and "E," have been launched—the former at the yard of Herr F. Schichau, Dantzic, on June 6; and the latter at the Germania yard, Kiel, June 12. They are sister ships to the Wittelsbach (ex-"C"), described in PROCEEDINGS *No. 97*, page 160.

PRINZ ADALBERT: LAUNCH, DESCRIPTION.—This vessel, formerly known as armored cruiser "B" (in the budget as 'Large Cruiser "B"'), was launched at the government yard, Kiel, June 22. She is nearly a sister ship to the Prinz Heinrich, launched March 22, 1900, but differs in the battery and in some other particulars. The hull is of steel, without sheathing. There are two military masts, each carrying one top; and two smokepipes. The bow is high and the superstructure extends from the stem to a point just forward of the after turret. The complement is 528; or, as a flagship, 571. The principal details are:

Armament.—Four 8.27-inch Krupp guns in pairs in turrets forward and aft, the forward turret being on the superstructure (or upper) deck, and the after one on the main deck. These turrets are reported to be trained by hydraulic power. Ten 5.9-inch guns—three each side in a long casemate on the gun deck, forward pair firing directly ahead, and after pair directly astern; and four in four turrets, two each side, over the casemates for the 5.9-inch guns. The top sides are carried inboard to permit bow and stern fire from these turrets. Twelve 3.47-inch guns in the superstructure and on the upper deck and bridges. Four machine guns. Five submerged torpedo tubes: one through the keel, twenty or thirty feet abaft the point of the ram, and two each side. One above-water torpedo tube in the stern on the berth deck, protected by armor.

Protection.—Complete belt, 7.5 feet wide, 3.9 inches thick amidships, and 3.2 inches at the ends. Above this, and extending up to the gun deck for a length of 165 feet amidships, the side is covered with 3.9-inch armor; and above this again is the casemate armor of the 5.9-inch guns. The protective deck, behind the belt and sloping down at the sides to meet the lower edge of the latter, is 2.8 inches thick on the slopes and 1.6 inches on the flat. The flat armor deck over the upper side armor, outside the casemate, is 1.2 inches thick; and the deck over the casemates is 1.4 inches. The turrets for the 8.27-inch guns are 5.9 inches thick and rest on barbette towers of the same thickness. The forward tower only extends down to the main deck and the after one to the gun deck; thence loading tubes extend to the protective deck. The armor of the 5.9-inch turrets is 3.9 inches thick in front and 3.2 inches in rear, and of the 5.9-inch casemates, 3.9 inches. The forward conning tower is 5.9 inches thick, and the after one 0.47-inch of special steel. The loading tubes for the 8.27-inch guns are 3.9 to 3.2 inches thick; for the 5.9-inch turrets, 3.2 inches.

Motive Power.—Triple-screw, 4-cylinder, triple-expansion engines, designed to develop 16,000 I. H. P. and give a speed of 21 knots. Fourteen Dürr water-tube boilers. Coal supply, at load draught, 950 tons; total capacity, 1500 tons.

Dimensions.—Length, 393.7 feet; beam, 64.3 feet; mean draught, 24.3 feet; displacement, about 9000 tons.

HEIMDAL, HILDEBRAND, BEOWULF: RECONSTRUCTION.—The reconstruction of these vessels on the same lines as that of the Hagen (see PROCEEDINGS *No. 97*, page 162; also photograph of the Hagen as reconstructed, PROCEEDINGS *No. 98*, page 391) has been commenced. The Heimdal is rebuilding at the government yard, Kiel, and the others at the government yard, Dantzic.

TORPEDO BOAT S_{102}: LAUNCH.—This boat, the first of the division S_{102} to S_{107} to take the water, was launched at the works of Herr F. Schichau, Elbing, on April 18. It will be speedily followed by the others of the division.

TORPEDO BOATS G_{108} to G_{113}: BUILDING.—These boats, contracted for this year, are building at the Germania yard, Kiel. Like their immediate predecessors, they are of about 350 tons, and therefore belong to the "destroyer" class.

ARIADNE: BOILER ACCIDENT.—The third-class cruiser Ariadne, 2645 tons, while undergoing trials early in July had a boiler explosion which caused the death of two men and seriously injured four others. The boilers of the Ariadne are of the Schultze type.

GREAT BRITAIN.

PERSONNEL: PRESENT NUMBERS.—In a Parliamentary paper which has just been issued the following return is given of the number of commissioned officers, subordinate and warrant officers, petty officers, men and boys of the various branches of the Royal Navy, borne on April 1, 1900, excluding pensioners and reserves. A similar return of the numbers of the commissioned, warrant and non-commissioned officers and men of the Royal Marine Forces was also issued and is appended: Executive Branch.—Commissioned officers, 1892; subordinate and warrant officers, including masters' assistants and cadets, 1974 (no masters' assistants are included in this number, as officers of that rank are no longer borne in the navy); petty officers, 7070; men, 28,875; boys, 9411; total, 49,222. Engineer Branch.—Commissioned officers, 889; subordinate officers, *i. e.*, engineer students, 196; warrant officers, 69; chief and other engine-room artificers, 3051; stokers, petty officers, 4475; men, 17,279; total, 25,959. Other Branches.—Commissioned officers, 946; subordinate and warrant officers, *i. e.*, clerks, assistant clerks and carpenters, 347 (including 13 head schoolmasters); petty officers, 4947; men, 5727; kroomen, 518; boys, 380; total, 12,865. Royal Marines.—Commissioned officers, 443; warrant officers, 39; non-commissioned officers, 2179; men, 15,800; total, 18,461. Grand total, 106,507.—*Marine Engineer* (London).

As noted in PROCEEDINGS *No. 98*, page 390, the total number of officers, seamen, boys, coast guard, and marines proposed for the year 1901-1902 is 118,635, being an increase of 3745 on the numbers proposed for 1900-1901, divided as follows: 287 officers, 1150 seamen, 500 stokers, 398 miscellaneous, 310 artisans (including 100 electricians), 1000 marines, 100 apprentices (shipwrights and coopers). The total number of officers, seamen, boys, coast guard, and marines provided for in the budget for 1900-1901 was 114,890, excluding the reserves, but probably including retired officers, pensioners, etc.

AMMUNITION HOISTS: ELECTRIC HOISTS ORDERED.—Orders have been given by the Admiralty to instal electric ammunition hoists on battleships and cruisers for all guns mounted in casemates.

BOILERS FOR SHIPS BUILDING.—According to recent reports the Challenger, Cornwall, Hermes, and Queen are to have Babcock & Wilcox boilers; the Montagu, Belleville; the Berwick and Suffolk, Niclausse; the Encounter and Media, Dürr; and the Medusa, Yarrow.

KING EDWARD VII, DOMINION, COMMONWEALTH: PARTIAL DESCRIPTION.—These new battleships are to be of 16,500 tons displacement, 18,000 I. H. P., and 18 knots speed. The protection is to be similar to that of the London class. The main belt, rising from the edge of the protective deck to 9 (?) inches above water, extends from stem to stern, and is 9 inches thick amidships. Above this the side, amidships, has 8-inch armor up to the gun deck. The armament will consist of four 12-inch guns in turrets forward and aft. Four 9.2-inch guns on the main deck, in turrets similar to those of the Cressy, one over each corner of the 6-inch battery, forward pair firing directly ahead, and after pair directly astern. Ten 6-inch guns in a central battery on the gun deck, separated by 2-inch splinter bulkheads. The thickness of the barbette towers and turrets for the 12-inch guns is not reported; that of the 9.2-inch turrets and barbette towers will be 6 to 7 inches, and of the side covering the 6-inch battery, 7 inches. These vessels are very similar to the first design of the Virginia and Rhode Island, substituting one 9.2-inch gun for two 8-inch, and reducing the number of 6-inch to ten.

NEW ARMORED CRUISERS: PARTIAL DESCRIPTION.—These will be similar to the vessels of the Monmouth class. The displacement will be 9800 tons and the speed 23 knots. The principal point in which they differ from their predecessors of the "County" class is the substitution of a 7.5-inch gun for each pair of 6-inch pieces which are mounted on the midship line forward and aft.

NEW THIRD-CLASS CRUISERS.—The two third-class cruisers of the new program are to be of about 3000 tons displacement and will have a speed of 21.5 knots.

NEW TORPEDO-BOAT DESTROYERS.—The ten destroyers of the new program are to be stronger in construction than their predecessors, and they will carry a larger supply of coal than the present 30-knot boats, but they will have the same speed.

CORNWALLIS: LAUNCH.—This first-class battleship was launched at the yard of the Thames Iron Works, Shipbuilding & Engineering Company, Blackwall, July 17. She is a sister ship to the Russell, fully described and illustrated in PROCEEDINGS *No. 97*, page 167.

LEVIATHAN: LAUNCH, DESCRIPTION.—This armored cruiser, the third of the Drake class to take the water, was launched at the yard of Messrs. John Brown & Company, Clydebank, July 3. The hull is of steel without sheathing. The freeboard is high forward. The forecastle extends about to the second smokepipe, but the bulwarks of the upper deck continue aft to the after bridge deck (which is at the same level as the forecastle), and the superstructure thus formed ends just forward of the after 9.2-inch gun. There are two signal masts each carrying two signal yards and a light top in which is mounted a searchlight. There are four smokepipes on the fore and aft midship line. The complement is 900, and the principal details are:

Armament.—Two 9.2-inch guns mounted singly in gun-houses over shallow barbette towers forward and aft. Sixteen 6-inch, 45-caliber guns, eight each side in double-story casemates, the four forward guns firing directly ahead and the four after ones directly astern. Fourteen 12-pounder guns: four each side on the main deck amidships in the spaces between the 6-inch casemates; one each side in a recessed port

on the main deck very far forward, and one each side on the gun deck very far aft in a similar port. Three 3-pounders. Two submerged torpedo tubes.

Protection.—The main belt is about 14 feet wide and extends from about 5 feet below water to the gun deck, on which rest the lower casemates. The belt is 6 inches thick and extends from the after 6-inch casemate, where the ends are joined by a thwartship bulkhead, to the forward 6-inch casemate. From this point to the stem the belt is of the same width, but only 2 or 3 inches thick. This thin belt covers the ram for some little distance back from its point. The protective deck extends from stem to stern. In the wake of the belt it is behind the latter and rises at the side from the belt's lower edge. Its thickness on the slopes is 3 inches, and on the flat, 2 inches. The gun deck, resting on the top of the belt, is 1 inch thick. The barbette towers of the 9.2-inch guns are shallow, not even extending so far down as the main deck forward, or the gun deck aft. An armored loading tube extends from the barbette armor to the protective deck. The barbette towers are 6 inches thick and the gun-houses 5 inches. The casemates of the 6-inch guns are 5 inches thick in front and 2 inches in rear. The conning tower is 12 inches thick.

Motive Power.—Twin-screw, 4-cylinder, triple-expansion engines, with cylinders 43.5, 71, 81.5 and 81.5 inches in diameter and 48 inches stroke. Weight of propelling machinery, 2500 tons. Revolutions of engines, 120, and piston speed, 960 feet when working at full power. Boilers: 43 Belleville; heating surface, 71,970 square feet; grate area, 2310 square feet; working pressure, 250 to 300 pounds. Designed I. H. P. of machinery, 30,000; corresponding speed on 8-hour trial, 23 knots. The coal supply at load draught is 1250 tons; total capacity, 2500 tons.

Dimensions.—Length between perpendiculars, 500 feet; beam, 71 feet; mean draught, 26 feet; displacement at this draught, 14,100 tons.

TEAL: LAUNCH, TRIAL, DESCRIPTION.—This shallow-draught gunboat, a sister to the Moorhen, still on the ways, was launched at the yard of Messrs. Yarrow & Company, Poplar, May 18, 1901. The dimensions are: Length, 160 feet; beam, 24.5 feet; mean draught, 2.25 feet; displacement, about 180 tons. The hull is of galvanized steel and is divided into twelve separate, floatable sections. These may be launched separately and are then bolted together, which enables them to be put together without great loss of time or the necessity of having skilled labor. The main deck rises only 3 or 4 feet above the water. Above this there is a two-story central superstructure containing the quarters, upper part of machinery, etc. The conning tower and the sides of the hull are bullet-proof, as is the plating of the superstructure protecting the boilers and quarters. This superstructure plating is loop-holed for rifle firing. The magazines are placed below the main deck with a ammunition hoists leading through the quarters to several small guns mounted on the superstructure deck. The vessel is propelled by twin screws working in specially designed tunnels under the stern which cause the water to rise and cover the screws, the blades of the screws extending some distance above the water line. Steam is supplied by two Yarrow water-tube boilers. The stern is square, and, to insure quick manoeuvering power, there are four rudders. There is a fan in the fire-room for forced draught, but this was not used on the trial and is intended only for use with particularly bad fuel, such as green or wet wood. The official trial took place May 24 over the Admiralty measured mile course. The mean results of six runs were: steam at boilers, 150 pounds; vacuum, 25.75

inches; revolutions, 282.9; speed, 13.045 knots. After the six runs on the measured mile, a three-hour trial took place, the mean revolutions being 282.6, equivalent to 13.033 knots, or 15 statute miles per hour. During one hour, wood fuel only was used. Forced draught was not resorted to, the fan being turned over slowly for the sake of ventilation only.—Chiefly from the *Engineer* (London) and *Engineering* (London).

INDUSTRY: LAUNCH, DESCRIPTION.—This steamer, designed as a transport for carrying guns, ammunition, and other stores between the dif-ent dockyards, was launched at the yard of Messrs. William Beardmore & Company (late R. Napier & Sons), Govan (near Glasgow). She is fitted with extra large hatches and the most modern appliances for the efficient working of the ship and the handling of heavy cargo. The general dimensions are: Length, 205 feet; beam, 30.5 feet; depth, 18 feet; normal displacement, about 1640 tons. The engines are 3-cylinder, triple-expansion, driving a single screw, and have cylinders of 18, 28, and 44 inches diameter and 30 inches stroke. The boilers are cylindrical, two in number, and are designed for a working pressure of 155 pounds.

BULWARK: TRIALS.—The trials of this first-class battleship of 15,000 tons have been completed with the following results:

Character of Trial.	Date.	Duration of Trial, hours.	Boiler Pressure, pounds.	I. H. P.	Revolutions.	Speed, knots.
At ¼ power....	May 21	30	226	3,174	66	11.2
At ½ power....	" 24	30	256	11,755	101	16.8
At full power .	" 28	8	280	15,358	110	18.15

FORMIDABLE: TRIALS.—This first-class battleship of 15,000 tons is a sister ship in all respects to the Implacable which is fully described in PROCEEDINGS *No. 98*, page 393. She has completed her trials with the following results:

Character of Trial.	Date.	Duration of Trial, hours.	Boiler pressure, pounds.	I. H P.	Revolutions.	Speed, knots.	Air pressure, inches.
At ¼ power	Mch. 27	30	233	3,262	.....	11.5	....
At ½ power	June 8	30	257	11,618	101.0	16.81	....
At full power..	" 13	8	280	15,511	109.4	18.13*	0.18

* Mean of 6 runs over the measured mile.

The draught on the full power trial was 26.5 feet forward and 27.75 feet aft.

VENGEANCE: TRIALS.—This lightly armored battleship of 12,950 tons, sister ship to the Albion, Canopus, Glory, Goliath, and Ocean, has completed her trials with the following results:

	Average of 30 hours, June 25 and 26, 1901.	Average of 30 hours, July 1 and 2, 1901.	Average of 8 hours, July 5 and 6, 1901.
Vacuum—port, inches..... .....26.7		25	26
" —starboard, inches.....26.5		25.5	26
Steam pressure in stokehold, lbs.....254		264.3	298
Steam pressure in engine room, lbs. 243		245.45	249
Revolutions—port, per minute.....65.88		102.12	110.5
Revolutions—starboard, per minute.....66.11		102.33	110.8
Total I. H. P. (collective).....2,885		10,387	13,852
Speed by patent log, knots 11.35		17.491	18.5
Number of boilers in use..... 8		20	20
Coal consumption per I. H. P., lbs..... 1.69		1.51	1.72

—*Engineering* (London).

ABOUKIR, SUTLEJ: TRIALS.—These first-class armored cruisers of 12,000 tons have completed their trials. They are in all essential respects sister ships to the Bacchante, which is fully described in PROCEEDINGS *No. 97*, page 168. The results of the trials are as follows:

Character of trial.	One-fifth power.		Four-fifths power.		Full power.	
Name of ship.....	Aboukir.	Sutlej.	Aboukir.	Sutlej.	Aboukir.	Sutlej.
Date of trial	April 30	April 21	May 3	April 19	May 7	May 9
Duration, hours	30	30	26	30	8	8
Boiler pressure, lbs..	280	....	248	248	285	280
Revolutions.....	74.5	75	114.3	113.5	123.2	122
I. H. P.....	4,591	4,679	16,274	16,604	21,352	21,261
Speed, knots	14.4	14.03	20.42	20.62	21.60	21.77
Coal per I. H. P., lbs.	1.9	....	1.77	1.9	1.84	2.3
Air pressure, inches.	nil	nil	nil	nil	0.27	0.5
Mean draught, feet..	26.25	26.25	26.25	26.25	26.25	26.25

—*Rivista Marittima, Journal of Royal United Service Institution*, etc.

PANDORA: TRIAL.—The full power trials of this third class cruiser of 2200 tons have been delayed for four months by leaky joints in her steam piping. On June 5, after being fitted with new screws, she had a successful full power trial with the following results: steam at boilers, 254 pounds; I. H. P., 7330; revolutions, 245; mean speed, 19.72 knots; coal consumed per I. H. P. per hour, 2.49 pounds.

VIPER: LOST.—On August 3, while taking part in the naval manoeuvers, and while running through fog at a speed stated to be 35 knots, the turbine-propelled torpedo-boat destroyer Viper ran ashore on the coast of Alderney. The bottom was knocked out of her, and she broke in half, becoming a total wreck.—*Engineer* (London), August 9.

RACEHORSE: ATTEMPTED TRIAL.—The trials of the torpedo-boat destroyer Racehorse have been interrupted by defects in the machinery.

EXPRESS UNSATISFACTORY TRIALS.—The torpedo-boat destroyer Express has recently attempted her fourth unsatisfactory trial. It was abandoned before completion on account of an accident to one of the intermediate cylinders. However, had the accident not occurred the trial would not have been satisfactory as the speed at no time approached the contract speed of 33 knots.

SPRIGHTLY: TRIAL.—On Wednesday, May 22, the torpedo-boat destroyer Sprightly carried out her official 30-knot coal consumption trial with successful results, obtaining 30.2 knots as the mean of six runs over the measured mile. The mean speed during three hours continuous steaming was 30.03 knots.—*Engineer* (London).

TORPEDO BOAT NO. 107: LAUNCH.—This boat, one of the two new ones described in PROCEEDINGS *No. 97*, page 170, was launched at the works of Messrs. J. I. Thorneycroft & Company, Chiswick, July 2.

TORPEDO BOAT NO. 99: TRIAL.—This torpedo boat, described in PROCEEDINGS *No. 97*, page 170, commenced her trials on May 25. The load carried on the trial was 42 tons and the speed attained, 25.06 knots. The contract requirement was 25 knots.

DARING: ACCIDENT.—An explosion took place in one of the boilers of the torpedo-boat destroyer Daring on June 10 causing the death of one man and seriously injuring four others, one of whom has since died. The Daring is one of the first destroyers built. Her displacement is 260 tons, designed speed 27 knots, I. H. P., 4200, and was fitted with Thorneycroft boilers which have been in service since her completion in 1894. The inquiry into the accident has shown that the opening

occurred in the lower tubes and let escape a flood of water and steam. Immediately after the accident a fire broke out, but it was rapidly extinguished.—*Le Yacht.*

TORPEDO BOAT NO. 81: SUNK.—Telegraphic dispatches in the daily papers state that torpedo boat No. 81, taking part in the manoeuvers, was sunk off the Island of Alderney. She struck the submerged ruin of the old breakwater, managed to reach the inner harbor and sank there. The guns and stores have been removed and she will be raised.

SHIPS IN RESERVE: CLASSIFICATION.—The ships in reserve are divided into five categories, as follows:

A. All ships which can be made ready for active service in 48 hours.

B. Ships which can be repaired and made ready for service in 30 days or less. Crews and equipments on board or ready to go aboard.

C. Ships which require more than 30 days to prepare for service. Crew not organized. Equipment not ready for putting on board. As soon as ships in this category are in such a condition of repair that they can be made ready in 30 days they are transferred to category B.

D. Dockyard Reserve.—Ships which need extensive repairs. No equipments on board.

E. All ships which do not appear to be capable of being put in condition to render active service with the fleet.—*Le Yacht.*

GREECE.

The government has decided to appropriate annually the sum of 2,500,000 drachmas (1 drachma = $0.193) for the purpose of improving and building up the fleet. It has also requested the French government to lend the services of a naval constructor who will be given charge of the program of construction.

ITALY.

BUDGET PROPOSALS FOR THE FINANCIAL YEAR 1901-1902.—The budget as submitted to the Italian Parliament is as follows:

I. ORDINARY EXPENDITURE.

Administrative Expenses:	Lire.
Ministry, personnel	970,000
Ministry, office expenses	63,300
Superior Council, staff, controller's office	64,000
Postal and telegraphic expenses	20,000
Printing, etc.	98,000
Small incidental expenses	700
Legal expenses	2,000
Counsellors and other cabinet expenses	4,000
Repairs	76,000
Unforeseen expenses	20,000
Total	1,318,000
Pensions, etc.:	
Pensions	5,395,000
Transportation	30,000
Total	5,425,000

Merchant Marine:	Lire.
Captain of port	1,098,074
Repairs to sailors' hospitals, etc	57,000
Rent for captains of port	17,000
Incidental expenses	120,000
Institute for merchant marine	218,572
Expenses of shipwrecks	30,000
Building and navigation premiums for steamers and sailing ships in accordance with law of July 23, 1896	10,000,000
Total	11,540,646
Expenditure for the Navy:	
Ships under construction, in reserve, under repair, etc	6,079,000
Executive officers	3,432,000
Marine engineers and machinists	1,340,000
Naval commissary corps	898,000
Surgeons department	671,410
Pay of men	12,500,000
Premiums for service and additions to pay of men	1,690,700
Aid department	100,000
Technical civil personnel	1,349,400
Bookkeepers, clerks, day laborers, and storehouse watchmen	1,445,000
Royal police	305,800
Semaphore and carrier pigeon services	410,000
Personnel of local defense stations	325,000
Food supplies for ships and shore stations	8,100,000
Barracks, quarters, watchmen, and lighting	208,000
Care of sick and hospital material	481,364
Gifts and gratuities	12,000
Coal and other fuel for ships	5,500,000
Materials for construction and repairs of ships, etc	1,700,000
Personnel for construction and fortification works for the navy	111,500
Marine (Naval) Institute	408,000
Free scholarships to the naval academy and engineering school	149,483
Hydrographic service, *personnel*	37,112
Hydrographic service, *matériel*	255,000
Counsel fees	32,000
Travel on duty and missions	500,000
Transportation of material and supplies	125,000
Repairs of ships	7,360,000
Labor for repairs of ships	5,790,000
Artillery and armament, *matériel*	7,100,000
Labor expenses for repair of artillery and war material	2,223,025
Repairing and improving buildings, fortifications, etc	2,253,600
Shipbuilding: For the construction of the battleships Benedetto Brin and Regina Margherita at Castellamare and Spezia; of the armored cruiser Francesco Ferruccio at Venice; for several torpedo vessels, local defence ships, steamers, navy-yard vessels, etc.; for commencing battleships of the first class; for reconstruction of the battleship Italia; and for the construction or purchase of colliers	24,000,000
Total	96,892,394

II. EXTRAORDINARY EXPENDITURE.

General Expenses:	Lire.
Care and expenses of reserve ships, etc.	38,000
Expenses of officers and employés for extraordinary works...	36,540
Total	74,540
Expenditure for the Navy:	
Ships under construction except those already mentioned.....	400,000
Coast defences	200,000
Fortification and armament of Maddalena	200,000
Torpedo purchases	500,000
Total	1,300,000
Miscellaneous:	
Equipment for ships in commission	3,500,000.00
Care of crown property given for marine purposes	2,664,125.85
Total	6,164,125.85

RECAPITULATION.

Administrative expenses	1,318,000.00
Pensions, etc.	5,425,000.00
Merchant Marine	11,540,646.00
Expenditure for the navy	96,892,394.00
Total of ordinary expenditure	115,176,040.00
General expenses	74,540.00
Expenditure for the navy	1,300,000.00
Miscellaneous	6,164,125.85
Total of extraordinary expenditure	7,538.665.85
Total of ordinary expenditure	115,176,040.00
Total amount of budget	122,714,705.85

(1 lira = $0.193)

These figures are derived from the *Mittheilungen aus dem Gebiete des Seewesens*, and is supposed to be a translation of the official Italian state paper "*Stato di previsione della spesa del ministero della marina.*" There are certain errors in the original footings of the columns which lead to the belief that an item of 1850 lire was omitted in "Administrative expenses"; and an item of 100,000 lire omitted in the "Expenditure for the navy;" or that items are in error to the extent of these amounts. Head 9, under "Administrative expenses," is missing. This may explain the 1850 lire. The total as given by the *Mittheilungen* is 122,816,555.85 lire. This is probably correct. The number of men provided for in the budget is 25,000, an increase of 500. Of the expenditure for fuel, 300,000 lire are for liquid fuel, 2,000,000 for 40,000 tons of coal for ships in foreign ports, and 2,736,000 lire for 76,000 tons of coal for ships in home waters.

REGINA MARGHERITA: LAUNCH, DESCRIPTION.—This first-class battleship, a sister to the Benedetto Brin, which is building at Castellamare, was launched at the Arsenal, Spezia, May 30, 1901. The keel was laid November 20, 1898. The hull is of steel without sheathing. The freeboard is of good height forward and aft. There is a central superstructure rising above the main deck amidships. There are two smokepipes and two military masts each carrying two tops and a signal topmast. The weights are as follows: Hull and equipment, 6195 tons; protection, 3155 tons; armament, including ammunition, etc., 1473 tons;

propelling machinery, 1603 tons; coal, 1000 tons; total, 13,426 tons. The complement is 625 men and 30 officers. The principal details are:

Armament.—Four 305-millimeter (12-inch) guns in turrets forward and aft. Four 203-millimeter (8-inch) guns in casemates on the main deck in the corners of the superstructure. Twelve 152-millimeter (6-inch) guns in an armored battery on the gun deck, each gun separated from its neighbor by a splinter bulkhead and the compartment containing each gun completed in rear by a continuous bulkhead running fore and aft. This is similar to the method of protection adopted for the lower battery of the Japanese battleship Mikasa and is a modification of the plan of the Kearsarge and Kentucky. The forward and after guns of the 6-inch battery are sponsoned out so that the forward ones fire directly ahead and the after ones directly astern. Sixteen 76-millimeter (3-inch) guns are mounted on the decks and bridges. Eight 3-pounders. Four torpedo tubes, two of which are submerged and the other two are on the forward berth deck behind armor.

Protection.—Complete armor belt, with a thickness of 5.9 inches for a length of about 262 feet, reduced to 3.15 inches at the ends. This belt extends 3.6 feet below water and rises 5.6 feet above it. Above the main belt, for a length of about 262 feet, and covering the side between the turrets, there is a second 5.9-inch belt rising to the gun deck. Above this again there is a 6-inch citadel containing the 6-inch guns arranged as already explained under the head of "Armament." The sides of the citadel are in line with the sides of the ship except where sponsoned out. At the ends, thwartship bulkheads extend inboard nearly at right angles to the ship's side and, if continued, would cross the ship just abaft the forward turret and forward of the after one. But after extending inboard for about one-fourth the beam, they turn squarely forward and aft and are then swept around the bases of the 12-inch turrets. Above the level of the main deck the armor of the turret base is circular in section. The protective deck is of the usual turtle-back form and rises from the lower edge of the belt. It is 3.15 inches in maximum thickness and 1.6 inches in minimum. The deck over the second belt, where it extends forward and aft beyond the citadel of the 6-inch guns, is also armored. The bulkheads at the ends of the second belt are 10 inches thick. The barbette towers of the 12-inch guns are 7.8 inches. The turrets are probably 7.8 inches in front and 5.9 inches on the sides. The casemates of the 8-inch and 6-inch guns are 5.9 inches. There are two conning towers, one forward and one aft, each 5.9 inches.

Motive Power.—The engines are twin-screw, 4-cylinder, triple-expansion, designed to develop 19,000 I. H. P. and give a speed of 20.5 knots. The cylinders are 37, 60.2, 69.3, and 69.3 inches in diameter with a stroke of 47.2 inches. Steam is supplied by 28 Niclausse boilers with a grate area of 144 square meters and a heating surface of 4674 square meters. The air pressure allowed on the forced draught trials is fixed at 0.4 inch. The anticipated I. H. P. with natural draught is 16,000 and the speed 19 knots. The coal supply at load draught is 1000 tons and the total capacity about 2000 tons.

Dimensions.—Length between perpendiculars, 426.5 feet; beam, 78.2 feet; mean draught, 27.1 feet; displacement at this draught, 13,526 tons (metric).

AMMIRAGLIO DI ST. BON: FORCED DRAUGHT TRIAL.—On the last forced draught trial this battleship attained a mean speed of 18.5 knots

with 14,277 I. H. P. The description of vessels of this class is given in PROCEEDINGS *No. 98*, page 398. The armament there given is incorrect, the eight 4.7-inch guns which these vessels carry being omitted, and the 1-pounders given as 19 instead of 10. The eight 4.7-inch guns are mounted behind shields on the upper decks and bridges very nearly over the 6-inch guns.

NEMBO: LAUNCH, DESCRIPTION.—This torpedo-boat destroyer was launched at the works of Messrs. C. & T. T. Pattison, Naples, on the 18th of May. She is built on plans furnished by Thorneycroft & Company and is one of four sister boats building at the Pattison yard, the names of the others being Aquilone, Borea, and Turbine. The hull is of steel plates, galvanized (*i. e.*, zinc-coated), and is divided into eleven water-tight compartments as follows: Beginning forward, the first is the collision department, containing water tanks and chain lockers; second, forward crew compartment; third, compartment for firemen; fourth, forward boiler compartment; fifth, after boiler compartment; sixth, engine compartment; seventh, petty officers' quarters and dynamo room; eighth, officers' quarters; ninth, machinists'; tenth, after crew compartment; eleventh, storeroom for provisions. The magazines and torpedo storerooms are in the lower parts of some of the compartments mentioned.

Armament.—One 3-inch gun on a platform above the conning tower with an arc of fire of 300 degrees. Five 6-pounders: one aft, two each side. Two torpedo tubes on central pivot mounts with arcs of train of about 90 degrees on each side.

Motive Power.—Twin-screw, 4-cylinder, triple-expansion engines, designed to develop 6000 I. H. P. and give a speed of 30 knots. Three Thorneycroft water-tube boilers, furnishing steam at 213 pounds per square inch. Coal capacity, 80 tons.

Dimensions.—Length between perpendiculars, 208 feet; beam, 19.6 feet; draught at full load, 6.33 feet forward and 7.5 feet aft; displacement, corresponding, 330 tons (metric).

SUBMARINE BOATS: RUMOR OF ORDER FOR TWENTY.—The Italian government, it is stated, has ordered twenty submarine boats of a type not stated. Colonel Cuniberti, the chief naval architect, is said to be a partisan of submarines, and so to some extent is the present Minister of Marine. Admiral Bettolo, on the other hand, who represents the chief part of Italian naval sentiment, is opposed to them root and branch. As he was till recently Minister of Marine, and is likely ere long to be so again, the course of Italy with regard to submarines promises to be interesting.—*Engineer* (London).

It is altogether unlikely that Italy has ordered so many boats. Her budgetary difficulties preclude such a course.

NETHERLANDS.

RINDJANI: TRIAL, DIMENSIONS, ETC.—This torpedo boat, a sister to the Orphir and Pangrango, was launched at the yard of Messrs. Yarrow & Company, Poplar, July 2, 1901, with steam up, and thirty-five minutes after launching she left the yard to undergo her trials. The mean results of six runs over the measured mile were: steam at boilers, 200 pounds; steam at engines, 186.6 pounds; vacuum, 23 inches; speed, 25.59 knots; slip, 12.1 per cent. After coming off the course the boat ran for some time at the measured mile speed. The dimensions of these boats are:

Length, 152.5 feet; beam, 15.25 feet; mean draught, 4.25 feet; displacement, 140 tons. The machinery is twin-screw, triple-expansion, and the contract speed requirement was 25 knots.

PORTUGAL.

RAINHA DONNA AMELIA: TRIALS, DESCRIPTION.—This small cruiser, built at Lisbon on the plans of M. Croneau, the French naval architect, has completed a series of trials satisfactorily. With natural draught, the results on a five-hour trial were: boiler pressure, 161 pounds; I. H. P., 3088; revolutions, 170; speed, 17.1 knots. During a run of twenty-four hours the speed was 15.75 knots with 162 revolutions. With forced draught during three hours the results were as follows: boiler pressure, 170.5 pounds; I. H. P., 5396; revolutions, 200; speed, 20.6 knots.

The armament of the ship consists of four 5.9-inch guns, two 3.9-inch, two 3-pounders, four machine guns, two torpedo tubes. The engines are twin-screw, triple-expansion, and the boilers are of the Normand water-tube type. The dimensions are: Length, 246 feet; beam, 36 feet; draught, 14.7 feet; displacement, 1660 tons. The hull is of steel without sheathing and the complement is 250.

RUSSIA.

GREAT FIRE AT GALERNAIA ISLAND SHIP YARD.—The great fire at the Galerny shipbuilding yard, St. Petersburg, on June 13, was a very serious affair, concerning which considerable secrecy has been observed. It broke out in the slip, built of wood, occupied by the first-class cruiser Vitiaz, in an early stage of construction, and in an incredibly short space of time slip and vessel became a roaring mass of flames. The fire brigades of the city were summoned, but before their arrival the adjoining workshops, the designers' office, and other offices were in flames. With the designers' office over 1000 valuable plans were burned, including, it is said, those of all the vessels building at St. Petersburg. The fury of the conflagration was such that the battleship Orel, building on an adjacent slip, was only saved with the greatest difficulty. She caught fire, but the flames were extinguished before they had done any great amount of damage. The first-class cruisers Pallada and Diana were also threatened, but were towed out into the middle of the river in time. Several lighters and other vessels, however, were consumed. While the cruisers were being removed, flaming splinters, carried across the River Fontanka by the wind, set fire to the immense navy provision stores, containing an enormous quantity of grain and other food stores, the bulk of which was soon destroyed, as well as a bridge across the Fontanka. The fire broke out about two in the afternoon, and at four it was raging over an area nearly two miles in circumference, and it was not until dark that all fears of a further extension of the conflagration were set at rest. The fire went on, however, until dawn, causing damage estimated at a total of about ten million roubles, including about a million for the Vitiaz, almost the only remaining trace of which is a deposit of about fourteen thousand hundredweight of molten steel. The most sensational reports are current as to the cause of the disaster, which is very widely believed to have been connected with the recent labor agitation. The belief in incendiarism is strengthened by the statements of various persons.—*Army & Navy Gazette.*

MATERIALS FOR SHIPBUILDING TO BE OF RUSSIAN MANUFACTURE. An ordnance, sanctioned by the Czar, has been promulgated by the Russian Minister of Marine, decreeing that all materials and articles used in the building of ships for the navy shall be exclusively of Russian origin and manufacture. Agents and representatives of foreign firms are to receive no orders in future, and in all contracts for the supply of shipbuilding materials it will be stipulated that they shall really be of Russian origin. It remains to be seen whether it will be possible to fulfil this condition.

CRONSTADT HARBOR IMPROVEMENTS.—During the coming summer the Imperial authorities intend to carry out a large scheme which has been drawn up with a view to deepening the harbor of Cronstadt. For this purpose the Ministry of Marine has ordered from the Scottish firm of Simons and Co., a steam dredger capable of working at a depth of 39½ ft.

SLAVA: ORDERED.—A new battleship about to be, or already commenced at the Baltic yard, St. Petersburg, is to be called the Slava (Glory). She is believed to be a sister ship to the Borodino, Orel, Imperator Alexander III, and Kniaz Suvarov, which were described in PROCEEDINGS *No. 97*, page 177.

ALMAZ: REMARKS.—The cruiser dispatch vessel, which appears in the table of "Ships Building" on page 177, PROCEEDINGS *No. 97*, and is referred to in the Russian budget on the same page, and in a note on page 180, is to be called the Almaz. She will be of the Novik type and will have a displacement of 3200 tons.

NEW CRUISER OF NOVIK TYPE ORDERED.—It is reported that the Russian government has placed an order with Herr F. Schichau, Dantzic, for another cruiser of the Novik type. The new vessel is to develop a mean speed of 25 knots on a 12-hour trial and is to carry six 4.7-inch guns in a citadel of 2-inch Krupp armor. She will, in addition, have eight 3-pounders, two Maxim machine guns, and six torpedo tubes.

KAGUL, OTSHAKOV: REMARKS.—These are the names given to the two new cruisers of the Bogatyr type, building on the Black Sea, the Kagul at Nicolaiev and the Otshakov at Sevastopol. These vessels are mentioned in the table of Russian "Ships Building" in PROCEEDINGS *No. 97*, page 177, also in the budget on the same page, and again in a note on page 180. The battery will be the same as that of the Bogatyr (see PROCEEDINGS *No. 97*, page 182), the I. H. P. of the machinery will be 19,500 and the speed 23 knots.

VITIAZ: DESTRUCTION, REMARKS.—This cruiser of the Bogatyr type was building at Galernaia Island, St. Petersburg. On June 13, she was totally destroyed in the great fire mentioned on a previous page. In the list of "Ships Building," given in PROCEEDINGS *No. 97*, page 177, she is noted as proposed.

IMPERATOR ALEXANDER III: LAUNCH.—This first-class battleship was launched August 4. She is a sister ship to the Borodino, fully described and illustrated in PROCEEDINGS *No. 97*, page 178. She was launched during a gale which blew down a flagstaff in the dockyard, killing an officer and a cadet and injuring the captain of the battleship and three cadets.

BOYARIN: LAUNCH, DESCRIPTION.—This protected cruiser is similar to the Novik, but has less speed. She is building at the yard of Messrs. Burmeister & Wain, Copenhagen, where she was launched June 8. She

has a raised forecastle and the upper deck is enclosed by a low rail to within about 75 feet of the stern. The details are not very definitely known. She was reported to have been launched last September and this error led the compiler to put her down as launched at that time in the list of Russian "Ships Building" which was published in PROCEEDINGS *No. 97*. The official and religious ceremony of affixing the silver plate to her keel, which is the Russian practice, probably led to the misconception, as I find that ceremony took place last September. Her principal details are:

Armament.—Six 4.7-inch guns: one forward on the forecastle; one aft on the main deck; two each side on the main deck amidships, but well apart. Eight 3-pounders: one each side on the after end of the forecastle; three each side on the main deck between the 4.7-inch guns. Two 1-pounders. Two machine guns. Five submerged torpedo tubes, of which one is in the bow and two are on each side.

Protection.—Complete protective deck and, perhaps, 2-inch side protection. Conning tower 3 inches thick on after end of forecastle.

Motive Power.—Twin-screw, triple-expansion engines, designed to develop 11,500 I. H. P. and give a speed of 22 to 23 knots. Sixteen Belleville boilers in three compartments. Three smokepipes. The coal supply is sufficient for 5000 miles at 11 knots.

Dimensions.—Length, 354 feet; beam, 42.6 feet; mean draught, 16.4 feet; displacement, about 3000 tons.

NEW TORPEDO BOATS.—The *Kronstadtski Viestnik* states that an order has been received by the Nevski Engineering Works, St. Petersburg, from the Russian Ministry of Marine to build five torpedo boats of the Tsiklon (Cyclone) type. The first two are to be ready by May, 1902, and each is to cost 240,000 roubles, or from 24,000l. to 36,000l., according to the rate at which the rouble is taken. The length of each boat will be 147 feet 7¾ inches; beam, 10 feet 2 inches; draught, 4 feet 9 inches; displacement, 150 tons; engines, 4200 indicated horse power, supplied by two Normand boilers having each 3211 square feet heating surface and 48.37 square feet grate area. Coal, and not oil, will be used; speed, 25 knots. Each boat will carry one torpedo tube on deck, and two 47-millimetre (1.85-inch) guns; and have a rudder fore and aft.—*Engineering* (London).

FORELLE, STERLIAD: TRIALS.—These torpedo-boat destroyers were described in PROCEEDINGS *No. 97*, page 184. The trials were "free route," like those of French destroyers, and consisted of a run of six hours, five of which at a speed of 22 knots, and one hour (neither the first nor the last) at full speed. The Forelle's trials, on April 30, gave: mean speed for five hours, 22.905 knots; full speed for one hour, 27.017 knots. The results of the Sterliad's trials, on May 3, were: mean speed for five hours, 22.546 knots; full speed for one hour, 27.381 knots. The weights carried on trial were about 75 tons.

NEW SUBMARINE BOAT.—A Russian engineer by the name of Kuteinikoff has built at Kronstadt a new electrically propelled submarine boat, designed by a lieutenant of the Russian navy, and of which the Russian government entertains great hopes.

COLLIER AND SCHOOL FOR FIREMEN.—The Russian government has ordered from the Germania Company, Kiel, a collier which is designed to serve as a school ship for firemen and machinists in addition to transporting coal, of which she will be able to carry about 4000 tons. She will

be fitted with all the auxiliary machinery ordinarily found on vessels of war and will have a large and complete workshop. Her boilers will be of the following four types: Schultz, Belleville, Niclausse, and Yarrow. The displacement at full load will be about 12,000 tons and the maximum speed will be 18 knots. The engines will be twin-screw, 4-cylinder, triple-expansion.—*Moniteur de la Flotte*, and other publications.

SWEDEN.

NEW SUBMARINE BOAT.—A Swedish engineer by the name of Enroth has presented to the Swedish admiralty the plan of a submarine boat. Its displacement when fully submerged is 146 tons; length, 82 feet; beam, 13.1 feet; depth, 11.5 feet. It is driven with twin-screw, triple-expansion engines, furnished with steam by two boilers using liquid fuel. The speed when running at the surface is expected to be 12 knots; when submerged it will be driven by the steam remaining in the boiler, supplemented by compressed air stored in tanks or compartments forward and aft. Two horizontal and two vertical rudders insure direction in both planes; and in addition a hydrostatic piston will maintain a constant depth of immersion. Submergence is effected by admitting water to cylindrical tanks and the estimated time to perform the operation is twenty-five seconds. Provision is made for descending to nearly two hundred feet below the surface and a special safety apparatus (allowing the compressed air to force the water out of the cylindrical tanks) enables the ascent to the surface to be very rapid. It will be armed with four 45-centimeter Whitehead torpedoes which can be launched from two tubes forward and two tubes aft.—*Le Yacht.*

TURKEY.

NEW CRUISERS ORDERED.—Referring to the order for a cruiser for the Turkish navy recently given to Sir W. G. Armstrong, Whitworth, & Co., a Reuter despatch from Constantinople says that for the last twenty-five years no purchases of this kind have been made in England; but all the orders for the army and navy (with two exceptions, namely, when the firms of Messrs. Ansaldo, of Genoa, and Messrs. Cramp, of Philadelphia, received contracts) have been placed with German houses. The contract price of the new cruiser is, roughly, 378,000l., payable in twelve instalments, the first of which is due now. The dimensions of the ship are as follows: Length, 330 feet; beam, 42 feet; displacement, 3250 tons. The engines will be of 12,000 indicated horse power, with a maximum speed of 22 knots. The armament will consist of two 15-centimeter, eight 12-centimeter, and six 47-millimeter quick-firing guns, besides six machine guns of 37 millimeters. The vessel is to be ready in twenty-two months, and will be put in hand as soon as the first instalment of the purchase money has been paid. —*Engineering* (London).

UNITED STATES.

DESIGNS FOR THE NEW BATTLESHIPS.—The following is from the *Army and Navy Journal* of July 20, 1901:

The Board on Construction of the Navy has been unable to agree as to the design for a sea-going battleship to be submitted to Congress. The majority, Admirals O'Niel, Melville and Bowles, recommend for adoption a battleship of which the following are the important particu-

lars: Length, 450 feet; beam, 76 feet, 3 inches; mean draught at trial displacement, 24 feet 6 inches; total displacement at trial, 15,560 tons; coal capacity, about 2000 tons; deep load displacement, 16,900 tons; deep load draught, 26 feet 4 inches; speed, 19 knots; indicated horse power, 20,000. The battery recommended is four 12-inch guns in 10-inch armored turrets and twenty 7-inch guns in casemates. Eight of these 7-inch guns are individually enclosed by armor—four on the upper deck and four on the gun deck—firing ahead and astern. The remaining twelve guns are located in the central casemate battery of the gun deck, separated by armored bulkheads into groups of four—two guns on each side which may be further subdivided as the details of the plans progress. The remainder of the battery will consist of twenty 14-pounder (3-inch) guns, of which twelve are protected by 2-inch side armor. The battleship is to have a complete armor belt 10 inches thick throughout the machinery space, 9 inches in way of magazine space, tapering to 4 inches forward and aft. Second belt, from protected deck to gun deck, 6 inches thick. Casemate armor on gun deck, 7 inches thick; casemates on upper deck, 7 inches thick, and 12-inch turrets in barbettes, 10 inches thick.

The report of the majority states that the Chief Intelligence Officer suggested the scheme now recommended by the minority, but has never seen or had an opportunity to consider the design of the majority. The essential difference between the majority and the minority recommendations is in the battery. The recommendations of the minority are as follows: Four 12-inch guns in two turrets; twelve 8-inch guns in six turrets, two of which are superposed on the 12-inch turrets, and two on each beam; twelve 6-inch guns in casemates on the gun deck, and eight 14-pounders (3-inch) guns. It will be seen that the majority recommends the ordinary turrets, and the minority, consisting of Rear Admiral Bradford and Captain Sigsbee, recommend the continuance as a type of the superposed turrets.

The report of the majority continues: "All other essential features of the design being the same (except the battery), the majority ship can be built upon a trial displacement of 15,560 tons, and a corresponding mean draught of 24 feet 6 inches. The minority ship will require, owing to greater weight of armor to protect a battery of the same weight, a displacement of 15,860 tons, making the mean trial draught five inches greater than the draught of the majority's design. This in itself is an objectionable feature.

"The principal points of difference between the battery plan of the majority and minority are that the majority do not recommend the further use of superposed turrets, and they recommend a uniform caliber of 7 inches for what may be termed the auxiliary battery, in preference to a mixed battery of 8-inch and 6-inch guns. The majority simplify the construction of the ship and the mounting of the battery by reducing the number of turrets (counting each double turret as two) from eight to two, and mounting all the 7-inch guns in armored casemates.

"The majority, in adopting this recommendation, have given careful consideration to other schemes involving the use of the 8-inch gun in lieu of the 7-inch, or a mixed battery of 8-inch and 6-inch, and find that the 8-inch gun, with mount, as now designed, weighing 29 tons, the gun being 28½ feet in length, is beyond the size which can be efficiently mounted singly in broadside.

"Through the recent development of a very powerful 7-inch gun we are enabled, in the opinion of the majority, to make a decided advance

on previous designs. It is possible, in the first place, to establish for the auxiliary guns a uniform caliber and mounting instead of a heterogeneous battery composed of two different calibers each differently mounted. It is possible, in the second place, to mount the auxiliary guns single in broadside, gaining marked advantages as regards rapidity of fire and simplicity and ease of ammunition supply, and avoiding the numerous practical objections to the mounting of guns in turrets, which are generally recognized and were brought particularly to the attention of our officers who saw active service during the Spanish War."

The majority says that from a comparison of muzzle energy and weight of metal fired in a minute, its design is appreciably superior, and it has in addition many advantages which cannot be reduced to calculation which were powerful with the majority in causing them to reach their conclusions.

"The allegation has been made that by mounting an important portion of the battery in casemates a greater portion is thereby liable to be disabled by a single well-placed shot than if the guns are mounted in turrets as in the minority's plan. While this statement is generally admitted in principle, the majority claim that in this respect their design is fully equal to that of the minority when due consideration is given to the fact that the minority, by the use of the superposed turrets, exposes four guns to displacement by a single shot, and by the mounting of the twelve 6-inch guns in a single casemate renders them all liable to be placed out of action by a single large shell charged with high explosives. In this connection the majority desire to repeat what is indicated in the general statement of particulars, that there is a greater subdivision of the battery by armored protection than in the minority's plan.

"The majority claim a very important advantage over the minority's plan in providing for twelve 14-pounder guns, as against eight. In increasing the caliber and amount of the auxiliary battery of 8-inch and 6-inch guns the minority has seriously affected the efficiency of their ship by the very great reduction in the number of the secondary battery, which is enforced by the decrease of available positions owing to the great sweep of the turret guns. In proposing the 7-inch guns the majority call attention to the fact that the tendency abroad is to increase the thickness of casemate armor and of what may be termed the light armor, generally, to such a degree that it cannot be perforated at battle range by the 6-inch guns; hence the necessity of a more effective rapid-firing gun. The 7-inch, having the essential features of such a gun in its style of mounting, breech mechanism and energy, seems, therefore, a most appropriate weapon, and the latest information from abroad indicates a tendency on the part of other nations to follow in this direction, the British having developed a 7½-inch rapid-firing gun, and the Germans a 6.69-inch gun."

The minority in their report lay much stress upon the desirability of retaining the 8-inch gun on account of its popularity during the Spanish War, to which the majority reply that had the modern 6-inch or 7-inch gun then been in service it would have been found more efficient than were the 8-inch guns then in use. The new 7-inch weighs 13.3 tons, and the old 8-inch 13.1. The muzzle energy of the 7-inch is 9225 foot tons, and the muzzle energy of the old 8-inch is 7,498 foot tons, showing that the new 7-inch gun is a more powerful weapon than the 8-inch gun used during the Spanish War, and its type of mounting and breech mechanism gives it a decided advantage in ease of manipulation and in rapidity of fire. The majority in their report cite as an example of what a dis-

advantage guns in pairs in turrets are at, as compared with those not in turrets and independently mounted, the great excess of shots fired at the battle of Manila Bay by the Boston over those fired by the Olympia. The report says:

"Uniformity of caliber, simplicity of mounting, separation of guns, giving independent action to each, are features of great importance, to which the majority have given special attention in the preparation of their plan, which presents a vessels more powerful than any yet built or projected by any power. During the Spanish War there was a general condemnation of turrets as being detrimental to efficiency of gun service. The heat, lack of ventilation, contracted spaces and great difficulty of seeing the enemy were commented upon at great length by officers who served in turrets. The majority submit the following comparison by muzzle energy and weight of metal thrown in one minute, of the guns comprising the main batteries of the two plans under consideration, omitting the 12-inch guns, which are the same in both cases. Majority plan: twenty 7-inch guns—Broadside fire, 230,620 foot tons M. E. per minute from each broadside; broadside fire, 4125 pounds of metal per minute from each broadside. Minority plan: twelve 8-inch and twelve 6-inch guns—Broadside fire, 253,174 foot tons M. E. per minute, from one broadside only; broadside fire, 187,882 foot tons M. E. per minute from other broadside; broadside fire, 4,500 pounds metal per minute from one broadside only; broadside fire, 3,300 pounds metal per minute from other broadside. All main battery guns except 12-inch: Majority plan, 461,240 foot tons M. E. per minute; minority plan, 411,060 foot tons M. E. per minute; majority plan, 8250 pounds metal in one minute; minority plan, 7800 pounds metal in one minute.

"The minority lay much stress upon the strength of end fire as provided for in their plan, which the majority concede to be very heavy; but it may be remarked that as the chief strength of a modern battleship's battery is in its broadside and not in its end fire, there is every probability that naval battles will, in the future, as in the past be fought broadside to broadside, rather than end on. The minority plan gives 2 more guns for end fire than does the majority plan; that is it gives six 8-inch as against four 7-inch, but as the latter are proposed to be mounted separately, having independent action, the majority believe they will prove as efficient as the six 8-inch guns in three turrets proposed by the minority."

Designs for the New Armored Cruisers.—The chief of the Bureau of Construction and Repair is now preparing plans for two armored cruisers which will be authorized by Congress at its next session. According to the instructions issued by the Board on Construction, these cruisers will be superior to foreign vessels of their type, and, in fact, will be superior to any armored cruisers ever built for this or any other country. Either way the battleship controversy is finally settled the two battleships which will form part of the naval increase next session will be more formidable than any of their type contemplated by foreign governments. So the cruisers are to be more formidable than other vessels in their class. A few weeks ago Rear Admiral Bowles, the chief of the Bureau of Construction and Repair, presented to the board plans for a 11,000 ton armored cruiser. The main battery consisted of four 8-inch guns and a number of 6-inch guns. According to the plans an excellent distribution of weight was made, and they hence received the almost unanimous approval of the Board on Construction. Rear Admiral Bradford, however, objected to the plans, arguing that

as England and other maritime powers are building armored cruisers of 14,000 tons displacement, this country should build vessels superior, if anything, but certainly not inferior in any respect. His view was accepted by the whole board, and consequently Admiral Bowles was directed to have prepared plans for a larger ship. It is expected that the plans will describe vessels having these general characteristics: Length, 502 feet; beam, 49 feet 6 inches; draught, 24 feet 6 inches; displacement, not less than 14,000 tons. Armament, eight 8-inch guns in four turrets, two forward and aft on the keel line of the ship, and one in each beam in the waist of the ship; fourteen 6-inch guns, most of which will be in broadside, and a strong secondary battery not yet determined. It is barely possible that the 8-inch guns will be replaced by 7-inch guns of the rapid-firing type. The board is divided on this qestion. The speed of the cruisers will be 22 knots; they will have coil boilers, vertical triple-expansion engines and twin screws, and a coal capacity of 2000 tons. There seems to be a growing tendency among naval experts to build more battleships in the future than armored cruisers. It is claimed by many of the best known naval constructors that they are generally more efficient and useful than the armored cruisers. This matter will be discussed in the near future and will probably be a subject for a report to be made by the Board on Construction.—*Army and Navy Journal*, Aug. 3.

Torpedo Boat Stations, and Care and Preservation of Boats.—The board of naval officers, of which Captain Converse is the President, appointed to report on the best method of the care and preservation of torpedo boats, has submitted a long and comprehensive report to the Secretary of the Navy. The board recommends that general torpedo boat stations be established at Portsmouth Grove, Cedar Grove, Norfolk; Chicora Park, Charleston, South Carolina; and Pensacola, Fla., on the Atlantic coast; and at Mare Island, on the Pacific coast. In order to keep the boats in the best possible condition the board urgently recommends that they be kept in commission all the time. When not possible to do so, however, the little craft should be "in commission in reserve," with half their regular crew. At each of the general stations the board is in favor of the construction of a wet basin, into which the boats could be placed when necessary. Only in case of absolute necessity, the board reports, should the boats be hauled out of the water for any repair. They should only be sent to navy yards when the repairs cannot possibly be effected at the general stations. The board urges that crews for torpedo boats be specially selected, trained men, who are never to be used for other duty. In case additional torpedo boats are built for the Navy, the board is of the opinion that additional general stations should be established. The report goes into great detail as to the best method of handling the torpedo boats, as to painting, cleaning, etc. Such is the importance of the report that the Secretary of the Navy will order that it be printed for general distribution. The board estimates the cost of the wet basin at approximately $100,000.—*Army and Navy Journal.*

New Dry Docks.—Plans for the new dry dock at the New York Navy Yard, for which bids will soon be advertised, provide for a dock of thirty feet in depth to be built of stone masonry and have every facility for docking the largest ships. Plans have also been drawn for the construction of a stone masonry dock even larger than the New York dock, at the new naval station at Charleston.

The Navy Department has purchased the floating dry dock which lies

in Havana harbor, from the Government of Spain for $185,000. Negotiations for the purchase of the dock were closed by Comdr. Lucien Young, Captain of the Port, at Havana. The original price at which the dock was offered by the Spanish Government was $250,000. It is stated by the chief naval constructor that the dock has been in constant use. Secretary Long has under consideration a recommendation of Admiral Bowles that the dock be sent to the Philippines. Admiral Bowles regards this plan as feasible. The British Government sent one of the biggest dry docks in the world from England to Bermuda, and another from England to Port Mahon in the Mediterranean.—*Army and Navy Journal.*

IMPROVEMENTS AT NEW YORK NAVY YARD.—The Navy Department is at last moving in the matter of improving the cob dock at the New York Navy Yard, and also the Whitney Basin in the same yard. The proposed improvements comprise the removal of some 20,000 cubic yards of crib work from the cob dock and about 100,000 cubic yards of dredging from the basin. With these improvements the Wallabout channel of the yard will become one of the best basins in the yard, and will add greatly to the conveniences and areas of the station. The contracts for the work have not been assigned, but it is believed that they will go to local contractors.—*Army and Navy Journal.*

NAVAL STATION IN PORTO RICO.—Following the necessities of the Navy, an investigation is on foot for the determination of the best point for the inauguration of a Porto Rican naval station. A board of Naval officers will soon be appointed to proceed to that island and report upon the advisability of establishing a naval station there. Admiral Luce, during his recently concluded tour among the West Indies, made some investigation looking to this object, but the present inquiry will embrace a much wider scope than was attempted by Admiral Luce, and will include in its field not only a rendezvous for ships, but the establishment of a first class naval station at one of the eastern outposts of the Antilles. The commission will be assigned the use of the Mayflower for the objects of their inquiry. It is not contemplated that anything more than a beginning will be made at the present time, but the ultimate idea of the Department is to perfect the establishment of a naval station in that part of the world which shall enable the Navy Department to cut loose from the Atlantic coast dock yards in case of necessity, employing the facilities intended to be established at Porto Rico for this purpose. Surveys for naval stations in Cuba, conducted by the Eagle, the Yankton and the Vixen on most of the chief harbors are now completed. The most important points are probably Cape San Antonio and Cape Maysi. At Cape Maysi it has been found that there is a reef running far out into the water, and that there is no suitable harbor within about forty miles of the Cape. The Bay of Nipe appears to afford the most available harbor in that locality. Cape San Antonio has no harbor of any kind in its immediate vicinity suitable for a naval or coaling station. Most of the large harbors along the northern and southern coasts have been surveyed and charted, those of Cienfuegos and Guantanamo apparently being among the best on the southern coast.—*Army and Navy Journal.*

PENNSYLVANIA: KEEL LAID.—The keel of this armored cruiser was laid at the yard of the William Cramp Ship & Engine Building Company, Philadelphia, early in July. The Pennsylvania belongs to the California class of armored cruisers fully described in PROCEEDINGS *No. 96*, page 714. The name was originally assigned to a battleship.

MAINE: LAUNCH.—The first class battleship Maine was launched at the yard of the William Cramp Ship & Engine Building Company, Philadelphia, July 27, 1901. She is fully described and illustrated in PROCEEDINGS *No. 98*, page 403.

TRUXTON, WHIPPLE, WORDEN: LAUNCH, DESCRIPTION.—These three torpedo boat destroyers were all launched on August 15, at the yard of the Maryland Steel Company, Sparrow's Point, near Baltimore. These are much the largest torpedo boat destroyers built for any navy, as their normal displacement is 433 tons and their displacement at full load, with bunkers full and all stores on board, 610 tons. The keels of all three were laid Nov. 13, 1899, and the contract date of completion was April 4, 1900. The hull is of steel. The complement is 4 officers and 69 men. The principal details are:

Armament.—Two 3-inch guns; six 6-pounders; two 5-meter, 17.7-inch torpedo tubes.

Motive Power.—Twin-screw, vertical, triple-expansion engines designed to develop 8,300 I. H. P. and give a speed of 30 knots. Thorneycroft water-tube boilers. Normal coal supply 25 tons; total capacity 202 tons.

Dimensions.—Length on the water-line, 248 feet; beam, 23.25 feet; mean draught, 6 feet; normal displacement, 433 tons; gross tonnage, 541.02; full load displacement, 610 tons; tons per inch of immersion at normal draught, 9.5.

BIDDLE: TRIAL.—This torpedo boat of 167 tons displacement completed her trials July 2. The results were 306.7 revolutions and 28.57 knots. The Biddle is a sister boat to the Bagley described in PROCEEDINGS *No. 97*, page 189.

BAGLEY, BARNEY: TRIALS.—These two torpedo boats have completed their trials and have been provisionally accepted by the Navy Department. The Bagley developed a mean speed of 29.15 knots for two consecutive hours and the Barney a speed of 29.04 knots for the same length of time. They are sister boats in all respects and were built at the Bath Iron Works, Bath, Me. A description of the Bagley, which applies equally well to the Barney, is given in PROCEEDINGS *No. 97*, page 189.

WISCONSIN: FINAL COMMISSION TRIAL.—The following brief summary of the report of the Trial Board appeared in the *Army and Navy Journal*, of June 29: The Navy Department has received the official report of the final trial of the battleship Wisconsin. The report, which is dated San Francisco, June 21, 1901, speaks in the highest terms of praise of the qualities exhibited by the battleship during her recent trial. The average speed of the vessel for two hours under natural draught was 15.8 knots per hour. The total indicated horse power was 7,790. The main engines on the starboard side showed 3,783 horse power and those on the port side 3,857 horse power.

The board announces that all the unfinished work reported by the preliminary trial board has been completed in accordance with the requirements of the specifications with the exception of finally adjusting the power of the turret-turning motors of the forward turret. The few items on the work of changes reported uncompleted by the first board, and which are still uncompleted, the board attributes to the absence of the vessel from the Union Iron Works and to the subsequent labor troubles over which the contractors had no control. The uncompleted work in ordnance, as listed in the report of the preliminary board, has been satisfactorily completed, and there are no other defects of workmanship in the installation for which the contractors should be held

responsible. The speed requirements for supply of ammunition were not attained, but the deficiency was due to the handling force being insufficient and inexperienced; but the mechanical appliances are fully capable of handling ammunition at the required speed under proper conditions.

The board reports: "The battery of the vessel was sufficiently fired to prove to the board that the guns, gun carriages and their fittings and appurtenances work properly and the vessel is sufficiently strong to stand the shock caused by firing." The telephone system does not work, and is entirely inefficient as a means of interior communication. The tests of the search lights showed that they fell short by several thousand yards of the requirements of the Department. The board says, however, that the atmosphere was hazy at the time the tests were made.

In regard to the engineer department of the Wisconsin the board reports that the engines, boilers, appurtenances and spare parts are in conformity with the contract, drawings and specifications, except in a few minor matters, to which attention is called. "The condition of the boilers is not entirely satisfactory to the board. From the history of their service and from present appearance it is evident that the best of workmanship has not been secured in their building. Five of the eight boilers have had, and still have, numerous leaks at stay bolts in back connections, at furnace overlap seams, also in back connections and at ends of the lower main stays over furnaces, both front and back. The fact that the three remaining boilers have no such serious leaks, although performing the same duty, shows that the defect does not lie in the design, and the board is of the opinion that the faults are directly attributable to inferior workmanship at these points. The contractors should be required to go thoroughly over this work and place the boilers in a satisfactory condition as soon as possible."

NEWARK: RECONSTRUCTION.—Some $500,000 is to be expended in rebuilding the U. S. S. Newark. She is due shortly at the navy yard, Boston, Mass., from the Asiatic Station. She will be placed out of commission at Boston, where the repairs are to be made.—*Army and Navy Journal*, June 29.

PHILADELPHIA: REPAIRS, NEW BATTERY.—The Bureau of Ordnance has at last succeeded in inaugurating a reform in the main battery of the U. S. S. Philadelphia, and as soon as that vessel arrives at the Mare Island Navy Yard from the Mexican ports, en route from Acapulco, it is certain that she will have the long-delayed modifications in her battery carried out. The time required for this work has not been accurately estimated, but it is probable that several months will be spent by the vessel at the navy yard. Considerable machinery overhauling will also be carried out.—*Army and Navy Journal*, March 30, 1901.

PETREL: REPAIRS, ETC.—The U. S. S. Petrel will be surveyed as soon as she arrives at the Mare Island Navy Yard, and will go out of commission then for a thorough repairing and modification in several important particulars. The Petrel will return to the Asiatic Station as soon as her repairs are completed, but this will not be for several months yet. She was launched at Baltimore October 10, 1898, the contract price being $247,000.—*Army and Navy Journal*, July 6.

REINA MERCEDES: RECONSTRUCTION.—Acting under instructions from the Secretary of the Navy, the Bureau of Construction and Repair has prepared and forwarded a full set of plans for the rebuilding of the Reina Mercedes, but nothing definite has been arrived at in regard to the matter of rebuilding this vessel.—*Army and Navy Journal*, June 15.

RAINBOW AND SUPPLY: FITTED FOR STATION SHIPS.—The Rainbow and Supply, preparing for service at the navy yard, New York, will be ready for commission very shortly. Each has been fitted with commodious living quarters and will be comfortable ships for the officers assigned to them. The Rainbow will be the headquarters of the Philippines naval station. The flag officer assigned to permanent duty at Cavite will take up his residence in her. The Rainbow has twelve sets of water distillers installed on board and she can distill all the water for the fleet in the Philippines. The Supply will go to Guam, where she will be stationed as the flagship of the governor of the island.—*Army and Navy Journal*, July 20.

MARQUES DEL DUERO: REFLOATED.—On May 4, at Cavite, P. I., a large cheering crowd witnessed the towing of the resurrected Spanish gunboat, the Marques del Duero, from her bed on the bottom to the dry dock. The vessels in the bay dipped their flags and their sailors lined the shrouds and shouted their greeting. The raising of this vessel occurred on the morning of May 1, three years subsequent to Dewey's sinking of the Spanish fleet. The Marques del Duero lay the farthest in the bay of the sunken vessels, with the exception of one. She appeared to be in good condition, especially below water, where she had suffered but little. Her hull and machinery were in splendid shape.

The Duero was an 800-ton gunboat with twin screws and a light battery. She was built in France in 1887. Her guns were dismounted previous to her being raised. Contractor W. H. Hoffman, who is raising the wrecks, expects to have several other vessels soon placed alongside the Duero. "Operations are now proceeding on the Bulusan," said the Manila *Times* of May 8, "and work will shortly be begun on the Don Antonio de Ulloa."—*Army and Navy Journal*, June 29.

ADDER, MOCCASIN: LAUNCH, DESCRIPTION.—These two submarine boats have been launched, the Adder on July 22 and the Moccasin on August 20. They are the first to take the water of the five similar boats building at the yard of Mr. Lewis Nixon at Elizabethport, N. J. The others are the Plunger, Porpoise, and Shark; while two more of the same class, the Grampus and Pike, are building at the Union Iron Works, San Francisco. These boats have a so-called cigar-shaped body, pointed at both ends, but somewhat sharper aft. The hull is of steel of extra thickness and is braced by numerous frames. On top, nearly amidships, is the conning tower, 21 inches in inside diameter and protected by armor 4 inches thick. Immediately forward of this, also on the outside, is the steering binnacle, so placed as to be observed through a slit in the armor of the conning tower. Still further forward there is a large manhole or hatch, through which stores and torpedoes may be taken in. An external rib of varying height runs along the backbone of the hull and acts as a rolling chock, or keel, in addition to preventing lines or obstructions from catching on the projections above the hull. A large supply of compressed air is kept in cylinders, sufficient for about 24 hours continuous submergence. The boats, which normally run at the surface with quite a good deal of the upper part of the hulls exposed, are submerged by admitting water to the ballast tanks and they are then in the "awash" condition. The dive is then effected by means of diving rudders. Having thus a small amount of buoyancy the boats will rise to the surface if the machinery becomes disabled and stops. The complement is not yet assigned. The contract price is $170,000 each. The details of armament, motive power, and dimensions are:

Armament.—This consists of one torpedo expulsion tube in the bow. Five Whitehead torpedoes are carried, each 17.7 inches in diameter and 11.65 feet long.

Motive Power.—When running at the surface, a single-screw, 4-cylinder, Otto gasolene engine, designed to develop 160 I. H. P. and a speed of 8 knots. When awash or submerged, storage batteries drive an electric motor of 70 I. H. P., giving a speed of 7 knots. It is expected that these speeds will be somewhat exceeded. The fuel supply is 850 gallons of gasolene, which will give a radius of action of at least 400 miles.

Dimensions.—Length over all, 63.3 feet; diameter, 11.75 feet; displacement when fully submerged, 120 tons.

ARMOR.

TEST OF 6-INCH PLATE FOR THE MAINE.—The second test of the 6-inch Krupp armor plate designed for the battleship Maine occurred June 11 at the Indian Head Proving Ground. The results were highly satisfactory. The partial failure of the first test was not due to faulty construction of the armor plate as a whole, but to a defect existing in one end of the sample plates tested. The first projectile fired in the test of June 11, a 6-inch armor-piercing shell, struck the target, made of the same plate, with a velocity of 2016 feet a second. The projectile smashed on the face of the plate, the total penetration attained being 3⅓ inches. Another shot penetrated 2½ inches, and a third only 1¾ inches.—*Army and Navy Journal*, June 15.

TEST OF 6-INCH PLATE FOR THE MISSOURI.—A test of the first specimen of the Krupp armor for new battleships, submitted by the Carnegie Steel Company, was made July 17 at the Indian Head Proving Grounds, Maryland. The plate represented a group of 412 tons of armor for the Missouri. It was six inches thick and a 6-inch gun was used. Three shots were fired, at velocities, respectively, of 1865, 1890 and 1900 feet a second. These secured penetrations, respectively, of 2¼, 2½ and 2¾ inches. No cracks were developed and the flaking and condition of the plates were normal. The test was regarded as highly successful and the group of armor will be accepted.—*Army and Navy Journal*, July 20.

NEW PROCESS FOR BUILDING UP HARD-FACED PLATES.—An experimental armor plate manufactured by a new process has recently been turned out from the works of the Carbon Steel Company at Pittsburg. By this process, when the steel ingot from which an armor plate is to be made is cast, half of the mould in which the ingot is cast is filled with a plumbago core. Soft steel is then poured in, filling the other half of the mould. When this has been cooled so that it will not run, the core is taken out and its place is filled with very hard steel. The plate is then finished by being rolled instead of forged. The result is said to be a plate with a very hard face, which resists the penetration of a projectile, combined with a soft back, which prevents the plate from being fractured.—*Engineer* (London).

This is a return to the compound plate system of a dozen years ago. The Messrs. Jessop, in England, endeavored to build up steel plates in this way, but they were not successful.

TEST OF 6-INCH COSGROVE PROCESS PLATE.—A test of an armor plate treated by the Cosgrove new face-hardening process was made at the

naval proving grounds, Indian Head, Maryland, on July 3. Two shots were fired from a 6-inch rifle at 6-inch armor plate, the first at a velocity of 2000 feet a second, perforating the plate. The shell broke in pieces. Some of the fragments penetrated the backing of the plate. The second projectile, fired at a velocity of 1490 feet a second, was not broken up, and its face was flushed with the hard surface of the plate. The result showed that the process had been improved since first tested several months ago; to what extent the official report of the trial will show.—*Army and Navy Journal*, July 6.

TEST OF 9-INCH PLATE FOR THE VENERABLE.—A 9-inch Krupp face-hardened plate was tested at Whale Island, near Portsmouth, England, June 25. It was one of several designed for the belt of the British battleship Venerable, and was made by Sir John Brown & Company, of Sheffield. A 9.2-inch gun was used. The projectiles weighed 380 pounds and were made by Messrs. Jacob Holtzer & Company, but it is likely that they were eight or ten years old, as the Messrs. Holtzer have recently stated that they have not furnished any projectiles to the British government for many years. The striking velocity was 1900 foot seconds and the maximum penetration 3.5 inches, but a crack which formed near the edge of the plate was 4 inches deep.

TEST OF NEW 4-INCH NON-CEMENTED PLATE.—Last week sample plates of 4-inch non-cemented armor submitted by Sir W. G. Armstrong, Whitworth & Company, Openshaw Works, Manchester, as specimens of armor for the cruiser Lancaster, the contract for which vessel, with her armor, has been placed with the firm, was tested at Whale Island, under the superintendence of Captain A. Barrow and Lieut. Drury-Lowe. The plates measured 4 feet by 4 feet, and each was required to stand three rounds of armor-piercing projectiles from the 4.7-inch quick-firing gun, fired with a striking velocity of 1635 foot seconds. The results of the tests showed that the service requirements were satisfied in every respect, the order for the armor being conditional upon the satisfactory tests of three plates. Five plates were tested, from which the necessary standards for guidance in manufacture of the armor for the above ship were selected. The average penetration was under 1 inch, and no cracks or bulges were developed on the backs of the plates, which were in the same state as before firing. Other plates of greater thickness and harder quality—namely 9-inch and 12-inch—are now being submitted by the same firm for trial under service conditions.—*Engineering* (London).

NEW VICKERS-MAXIM PLATE.—A new armor plate by some special process invented by Messrs. Vickers-Maxim, so we hear, has been tested at Whale Island. As to what the process may be we are ignorant; but we do know that so far 6-inch projectiles that ought to have made an impression on it have failed to do so. They simply "danced off," according to all accounts.—*Engineer* (London).

ARMSTRONG & CO. ACQUIRE RIGHT TO MANUFACTURE BY KRUPP PROCESS.—It is announced that the firm of Sir W. G. Armstrong, Whitworth & Co. has practically concluded an arrangement which will enable them for the future to make armor plate by the Krupp process up to any thickness—a privilege which had been confined hitherto to the three Sheffield firms and to Beardmore & Co., of Glasgow.—*Engineer* (London).

THE MANUFACTURE OF ARMOR IN GERMANY.—The question as to the manufacture of armor plates has again been raised in Germany, in consequence of the circulation of reports relating to the intentions of the government in regard to the matter. It may be remembered that a few

months ago, when considering the navy estimates for the current financial year, a resolution was adopted by the Reichstag expressing the opinion that the government should establish state works for the production of armor plates, with the object of economizing the national expenditure on this item of construction in connection with the large scheme for increasing the German Navy. It is now reported by some of the German papers that the government does not propose to erect such works, and, it is added, that armor plates can at present be obtained from Messrs. Krupp—who, with the Dillingen Works of the late Baron von Stumm, have a monopoly of this trade in that country—at cheaper prices, seeing that the adoption of the navy extension program has enabled the government to conclude contracts on a large scale, whereas in former years it was only possible to buy in detail, that is, in small quantities. The statements made to this effect have apparently aroused the ire of the Cologne *Volkszeitung*, which points out that the latest naval scheme was adopted over a year ago, and that there are no essential alterations in the requirements in the matter of armor plates for 1901 and subsequent years in comparison with 1898, 1899 and 1900. The assertion that it is now possible for the government to enter into large contracts is characterized as quite incorrect, as everything is subject to annual sanction through the Budget. It is, however, obvious from the reports that the authorities of the Admiralty do not intend to give effect to the resolution of the Reichstag in favor of the establishment of a government armor-plate manufactory, the reason adduced being that no reduction in the price would be obtained by producing under State auspices. The Cologne paper submits that this is an extremely naive explanation, as the persons in authority should know full welll that the cost to the manufacturers of armor plates hitherto sold at £116 per ton only amounts to from £48 to £50, and that even if a reduction has now been made to £96 per ton the makers still receive a profit of 100 per cent. Do the naval authorities, the paper continues, really believe that they would under all circumstances be compelled to produce armor plates in government works at a price of 100 per cent. higher than the cost incurred by the present makers? In this connection it may be mentioned that some time ago a Rhenish syndicate expressed its readiness to commence the delivery in 1903 of nickel steel armor plates of the same quality as those now used at the rate of £77 10s. per ton, or £38 10s. per ton less than the price hitherto paid, provided that the government would undertake to give it a fair share of the orders for armor plates. This offer appears to have come to the knowledge of the present contractors, who have agreed to reduce the price to £96 on the assurance that the government would obtain all its supplies from them until the year 1907. As far as purchases in detail are concerned, the Cologne organ mentions that during the years 1898, 1899, and 1900, the deliveries of armor plate to the Admiralty amounted to from 16,000 tons to 18,000 tons, at a price of about £1,850,000 to £2,050,000, leaving a profit to the manufacturers ranging from £1,000,000 to £1,500,000. It is, of course, highly questionable whether the profits amount to anything like the extent cited by the Cologne paper in the case of a specialized industry such as that of manufacturing armor plates, where a large capital expenditure is required for the purpose of equipment with complete modern machinery, the value of which has to be written down considerably every year, in view of prospective improvements in the manufacture which may possibly cause a plant that is up-to-date at the present time to become

antiquated in from five to ten years. At the same time, the fact is interesting that a Rhenish syndicate has expressed its readiness to supply armor plates at £77 10s. per ton by the year 1903, although no government would be disposed to commit itself to delay in delivery by awaiting the pleasure of a new undertaking to start an industry of which it has had no previous experience. The name of the Rhenish syndicate does not appear to have been disclosed, but a Hoerde correspondent now states that the well-known Hoerde Verein has announced that it is prepared to furnish large quantities of nickel steel armor plates. Whether these two are identical is a matter for conjecture, but there is no doubt that the manufacture of armor plates is engaging a larger share of attention in Germany at the present time.—*Engineer* (London), June 14.

COMMUNICATIONS.

NOTE.—Under this head will appear notes on Signaling, Telegraphy, Ocean Cables, Carrier Pigeons, etc.

WIRELESS TELEGRAPH APPARATUS FOR BRITISH SHIPS.—The Admiralty has informed the Devonport dockyard authorities that battleships and cruisers in commission for the home stations, and all vessels being prepared for the Reserve, Training, and Channel Squadrons, shall be fitted with wireless telegraph apparatus. All future battleships and cruisers sent to the Mediterranean are also to be so equipped. Apps-Newton coils are being used.—*Engineer* (London), May 24.

CONSTRUCTION.

NOTE.—Under this head will appear notes on Design, Materials, Sheathing, etc.

FIRE-PROOF WOOD IN U. S. NAVY.—The Secretary of the United States Navy, on June 22, approved a unanimous report of the Board of Construction, recommending the discontinuance of fireproof wood for decks and for all joiner work below protective decks on vessels having protected decks, and on all vessels below the berth deck. Wood treated by the fireproofing process will be used, however, in torpedo boats and torpedo- boat destroyers, and will be painted. In other ships metal will be used in place of wood wherever possible. The recommendation of the board was based on reports received concerning the utility of fireproof wood. A bonfire was made of fireproof wood taken from the decks of the Helena at Manila. The surgeon of the Wisconsin complained that mould gathered on the fireproof wood of his sick bay. The reports of U. S. Naval Constructor Baxter, who made tests at Boston, showed that the wood when exposed to the weather for a week loses 50 per cent. of its fireproofing qualities, and that the fireproofing process made wood brittle.—*Engineering* (London), July 12.

WOODEN DECKS NO LONGER USED IN BRITISH NAVY.—An Admiralty order has been issued directing that there are to be no wooden decks in any warship laid down in the future or now building, nor is it to be used in the construction of the cabins.—*Army and Navy Journal*, July 20.

SHEATHING OF THE ARGONAUT: GALVANIC ACTION, ETC.—We are sorry to hear from the China Station that the bottom of the Argonaut is said to be in a bad way. The wood sheathing seems to have been loosened in some way, admitting water, which is setting up galvanic action. It is possible that the ship will be ordered home at the end of her com-

mission, or before; facilities for the necessary repairs being hard to obtain.—*Engineer* (London), June 28.

This is the third vessel in this class in which the sheathing has given trouble and the fact seems to indicate that the method of applying the sheathing is in some way faulty. But in the absence of definite details we can arrive at no conclusion.

GUNPOWDER AND EXPLOSIVES.

COMPARISON OF THE ENERGIES OF SMOKELESS AND BROWN POWDERS.—The following table is furnished by Lieutenant W. G. Turpin, U. S. N., on duty at the Indian Head Proving Grounds.

Gun.	Length Calibres.	Weight Charge.	Weight Projectile.	Muzzle Velocity, f. s.	Muzzle Energy, ft. tons.	Energy per pound of Powder.	Cost per ft. ton of Energy.	Remarks.
13″	35	286	1100	2340	41753	146	.006165	Navy Smokeless.
12″	40	353	850	2822	46950	133	.00677	" "
12″	35	213	850	2252	29883	140	.00643	" "
8″	35	62.6	250	2367	9709.6	155	.0058	" "
6″	40	27.8	100	2456	4183	151	.00598	" "
6″*	45	36	100	2828	5544	154	.00583	" "
6″	50	45.5	100	2922	5919	130.1	.00692	Navy Smokeless.
6″	45	29.9	100	2821	5516	184.5	.00488	Cordite.
13″	35	515	1100	1998	30440	59.11	.00542	Brown Prismatic.
12″	35	406	850	1955	22521	55.5	.00576	" "
8″	35	885	250	1802	5627.3	63.2	.005062	" "
6″	40	41.5	100	1932	2587.5	62.35	.00513	" "

*The data given for this piece with Navy smokeless are meagre.

Referring to this table, Lieutenant Turpin says:

"From the above table it appears that the cost per foot ton of energy is different for different guns; also that the navy smokeless is more expensive per foot ton of energy than is brown powder, and cordite is the least expensive.

"There is a variation in the cost, no two calibers of guns giving the same figures; but if the guns be arranged in the order of cost for the two powders we will see that they are in the same order in each case. This arrangement is as follows: 8-inch, L/35; 6-inch, L/40; 13-inch, L/35; 12-inch, L/35; 12-inch, L/40; 6-inch, L/50.

"In computing the energy for smokeless powder, cases have been taken in which the powder was completely burned and no energy was lost through incomplete combustion. The cost per ton of energy for each powder is computed using a cost of $0.90 per pound for smokeless powder, but it can now be bought for $0.70 per pound, hence the cost per foot ton of energy using navy smokeless powder should be much reduced.

"The mean energy per pound of powder is 142.5 foot tons for smokeless powder and 60 foot tons for brown powder, and the mean cost per foot ton is therefore $0.00632 for smokeless powder and $0.00533 for brown.

"With smokeless powder at 70 cents per pound the cost per foot ton of energy with smokeless powder would be $0.00493, which makes it cheaper than brown, considering the work done, and nearly as cheap as cordite."

NEW SMOKELESS POWDER.—Lieutenant J. B. Bernadou, U. S. N., has patented (date of British patent April 24, 1901) a smokeless powder which is briefly described as follows: Nitrocellulose of the kind insoluble in a mixture of ether and alcohol at ordinary temperatures is worked in a doughing machine with ether alone while subjected to an excessively low temperature, such as may be produced by liquid air. The resulting colloidal substance is used with other insoluble nitrous matter to constitute a smokeless powder, which, containing as it does ether alone as a solvent, can be more perfectly dried than powders in which water and alcohol are constituents.

SMOKELESS POWDERS: CEMENTING AGENT.—Lieutenant Bernadou has also patented (date of British patent April 20, 1901) a cementing agent or binder for the use in the manufacture of smokeless powders and briefly described as follows: A colloid which may be used after drying as an explosives cementing agent, consisting of insoluble nitrocellulose immersed in ethyl ether. This is exposed to a very low temperature, below that of freezing ethyl alcohol, 95 per cent. absolute volume, and it goes into solution or forms a jelly resulting in the formation of the colloid. Once in solution the nitrocellulose does not again revert to its original form, but constitutes a body which may be used as a binder in the manufacture of smokeless powders containing other ingredients.

THORITE: REMARKS.—Ordnance officers are so decidedly of the opinion that thorite is worthless as compared with several other things that caution should be shown in committing the government to its use. An officer who has experimented with this explosive, says: "We never tried so hard to get something out of nothing as we did with thorite. It is useless; turns to water in twenty-four hours on exposure, and is simply one of a dozen other hazards that have been grabbed for in the hopes of getting hold of something new."—*Army and Navy Journal.*

Thorite is a mixture of nitrate of ammonia and a hydro-carbon, such as coal tar or asphaltum, containing ten to fifteen per cent. of the latter. As nitrate of ammonia is a salt without a metallic base the products of combustion are wholly gaseous. It contains, besides, sufficient oxygen for the combustion of the hydro-carbon. Thorite is prepared by melting the hydro-carbon and stirring in the nitrate of ammonia. The hydro-carbon thus covers the nitrate of ammonia and to some extent protects it from the air. Nevertheless the protection so afforded is insufficient and the nitrate absorbs water from the atmosphere so fast as to render it inert unless the greatest precautions are taken. The first tests of thorite as a shell charge were fairly successful. It was perfectly safe to fire with the highest pressures and velocities and it broke up the shell in a satisfactory manner. It would not, however, stand firing through thick armor, packing forward with such violence that the explosion took place before complete perforation. This packing forward carried it away from the fuse when firing through thin armor and usually prevented explosion. When loaded under pressure sufficient to prevent packing the density rendered it inert and very difficult to explode—practically impossible, in fact. In addition to its hygroscopic tendencies, thorite was found to be very erosive, attacking the metal of the shell and of the fuse stock, and at the same time destroying its own power.

EXPLOSION OF NAVAL MAGAZINE AT MARE ISLAND.—The *New York Tribune* of June 22 reproduces a remarkable photograph of the explosion of the powder magazine at the Mare Island Navy Yard at 6 A. M. on June 5, in which half a million dollars' worth of government explosives

went up in smoke. An enterprising photgrapher who happened to be up early secured an excellent snap shot of the gigantic cloud of gas, several miles high, from a point near Vallejo, Cal., one and a half miles from the scene of the explosion.

This picture is perhaps unique, for the gas was chiefly that from smokeless powder, which lasted only a few moments. Showing the enormous height to which the column ascended, it explains clearly why no greater damage was done to the surroundings. The magazine was a stone structure, with walls nearly five feet thick, covered by a light roof. The building measured 150 feet by 50 feet. It contained 300 tons of powder, most of it the new smokeless variety made since the Spanish War, costing $1800 a ton, with a small quantity of old brown powder, valued at $500 a ton. It was apparently ignited by spontaneous combustion, fortunately at an hour when no workmen or keepers were near, and beyond a slight initial shock and rumbling, was noiseless. The roof was shattered and lifted so high that a large section of it fell at Valona, more than two miles away. The quick destruction of the roof, releasing the gases from confinement, had the effect of converting the magazine into a huge mortar, with muzzle vertical, and its entire charge was blown straight up, igniting, as it went. After the photograph was taken, buildings surrounding the magazine ignited, and the white cloud was replaced by black smoke. Five engines from the navy yard and from Vallejo and many tugboats got the fire under control in an hour and extinguished it in course of the day.—*Army and Navy Journal*, June 29.

GUNS.

GATHMANN 18-INCH TORPEDO GUN.—This is Mr. Gathmann's name for his gun. The gun resembles an ordinary gun of 30 calibers length, except that the jacket and long chase hoop are rather thinner in proportion and the usual outside hoops are omitted. As the designed chamber pressure is only 9 tons, the strength of the piece seems ample. It is designed to throw large charges of high explosive. The shells are of nearly the ordinary shape and weight for a caliber of 18 inches, but have thin walls and are otherwise modified internally. The principal details are:

Total weight, 59.6 tons; total length, 44.0 feet; diameter over chamber, 45.0 inches; thickness over chamber, 13.7 inches; maximum tangential strength per square inch, 40,300 pounds; maximum radial strength per square inch, 38,500 pounds; rifling, Gathmann type; twist, zero to 1 in 25; powder charge, 310 pounds; projectile, 1,800 pounds; pressure in chamber (maximum), 20,000 pounds; muzzle velocity, expected, 2,100 foot seconds; gun-cotton charge of torpedo shell, 600 pounds; weight of torpedo shell, 1,800 pounds; muzzle energy at 2,100 foot seconds, 55,000 foot tons.

Mr. Gathmann claims that from tests which have been made with 12-inch torpedo shells fired at velocities exceeding 2100 f. s. that it has been determined that a forward direction is always given to the explosive wave when the torpedo shell is exploded by a base fuse. It is not exactly clear what Mr. Gathmann means, but if he desires to convey the meaning that the force of the explosion is expended chiefly in one direction, as humble students of the laws of motion and of the action of explosive gases, we certainly must dissent. But, of course, the force of the ex-

plosion may be very great in any direction. The Gathmann gun here described is soon to be tried against a 12-inch Krupp armor plate in competiton with the army 12-inch service rifle of nearly equal weight and cost.

NEW SKODA 9.45-INCH GUN.—The Skoda Company, of Pilsen, Bohemia, is now building guns of large caliber. The first of several 9.45-inch guns for the Austrian Navy was recently tested with satisfactory results. Thirty rounds were fired with full charges, the gun being examined and gauged after each shot. No deformation or weakness was discovered. The gun is to be placed on board one of the new battleships of the Habsburg type (see PROCEEDINGS *No. 97*, page 151), which will be launched in October. The marine committee, before whom the test was made, decided not to adopt the Vickers breech system but to retain the Krupp wedge on the ground that the adoption of the former would entail a dependence upon Great Britain for naval guns. The process of reasoning by which this conclusion is reached is not clear. Possibly the Skoda Company declines to purchase the right to manufacture under Vickers' patents.

DAWSON AND SILVERMAN SEMI-AUTOMATIC MECHANISM.—Lieut. A. T. Dawson and Mr. L. Silverman, of London, have brought out a new type of semi-automatic mechanism applicable to the Hotchkiss type of rapid firing guns. The recoil of the piece opens the breech, extracts the empty case, and locks the block. A hopper holding three cartridges is located above and to the rear of the breech. The brief of the patent specification is not very clear, but apparently the empty case flying to the rear trips a spring and causes the lower cartridge to be dropped and thrown forward with an impulse sufficient to load it and trip the clutch holding the breech block down, which latter then rises and closes the breech ready for firing. The hopper is fed from the top and is kept supplied by the loader. If the operation of this gun is as above described and works satisfactorily it is a splendid solution of the semi-automatic problem.

BARRY AND PEMBERTON RAPID FIRING MECHANISM.—Mr. J. H. Barry and Mr. R. I. Pemberton, of Lee, England, have brought out a special type of breech mechanism. The gun is furnished with a double breech, or two chambers, which alternately take up the position for firing through an oscillating movement. The two chambers of the breech block are loaded by two slides which are fitted with hoppers containing the cartridges. The oscillating movement is produced by a lever which has a rocking action. The lever may also be used for firing.

NEW BETHLEHEM BREECH CLOSURE.—The Bethlehem Steel Company have recently taken out patents for a new system of breech closure, the date of the British patent being May 18, 1901. A brief description of the system is given as follows: "A breech mechanism for ordnance, in which the screw-box and the breech-block are provided with threads, the faces of which threads coincide with involute curves or are composed of a succession of relatively eccentric circular arcs. Thus the threads make contact throughout their entire length when the breech is closed, and the threads on the block are parallel to those on the box when the block is in its unlocked position, and there is, therefore, a uniform and a least possible clearance."

VICKERS-MAXIM 7.5-INCH GUNS FOR SPAIN.—It is reported that the Spanish government has placed a large order with the Vickers-Maxim Company for some of its new 7.5-inch guns. A special naval commission from Madrid visited London in May to examine these pieces. The

statement concerning the order must be regarded as doubtful until we find that the Spanish government is going to build ships to put the guns on. It is of course possible that they will replace the 9.4-inch guns of the unfinished cruisers of the Maria Teresa type, which in turn replaced the 11-inch guns of earlier ships of the same class.

PROPOSED GUN FACTORIES IN ITALY.—It is stated on fairly trustworthy authority that the French company, Schneider, of Creusôt, and the much talked of German firm of Ehrhardt, are both engaged in obtaining sites in Italy, at Milan and Spezzia, for the establishment of factories. There seems to be a very keen competition among the continental companies for the securing of the Government orders of the various European powers, and Italy is generally regarded as a happy hunting ground in the process.—*Arms and Explosives*, June, 1901.

SIMPSON AUTOMATIC RIFLE.—In regard to this piece, *Arms and Explosives* says: That ingenious inventor, Mr. W. S. Simpson, has recently turned his attention to warlike devices of a death-dealing nature. One consists of what has been described as a "bijou Maxim" gun, which is almost capable of being carried in the pocket. At all events, it can be transported by one man, and is worked by him without any assistance. In action, he plants the gun on the ground, with a sort of saddle-frame attached to the hinder end, and assumes a prone position across the saddle, thus holding the gun firmly in position. The elevation and direction of the gun are secured by means of the ordinary elevating and traversing screws. Twenty cartridges are fed into the gun at a time from the right-hand side of the chamber, and it is claimed that 100 rounds can be fired per minute. Apparently, this machine-gun is also capable of being fired from the shoulder, if necessary, as it weighs only 3 lbs. more than the service small-arm. Another device of Mr. Simpson's provides for fitting an ordinary military rifle with rests, so that a man need only assume the prone position, fix his rests in the ground, and start pumping lead and nickel for all he is worth. These rests can be folded up along the rifle when not in use, and do not interfere in the slightest with the use of the rifle as a shoulder-piece, or with the employment of the bayonet. It looks, at the outset, as if Mr. Simpson had struck on two good ideas; but in the absence of extended trials made under Service conditions, one can scarcely say more than this. Many ingenious inventions fall short under practical tests of a rough-and-ready nature.

AUSTRIAN FIELD GUNS.—Up to the present, three batteries of six pieces each of C/99, belonging to the 3d, 4th and 10th brigades of artillery, have been issued for trial.

The caliber is 7.65 centimeters (3.01 inches). The pieces are made of forged bronze, perfected by a process devised by General von Tiele. The cartridges are in metal cases (at present and provisionally separate from the projectile). The breech closure is eccentric, similar to that of Nordenfeldt and Deport, yet considerably more simple. Two or three batteries of six pieces of this type, but built of nickel steel by the Skoda Company, will next be issued; also bronze shell-guns of the field howitzer type of caliber 10.5 cm. (4.13-inch). There is in service under trial a mountain battery of 7.2-cm. caliber, also of bronze, and with the new breech mechanism. A battery of three or four pieces of the Ehrhardt type will be tried during this year. It is to be noted that the batteries under trial are placed under the authority of commanders of divisions of infantry.—*Revue du Cercle Militaire.*

NEW ITALIAN FIELD GUNS.—A battery of six of the new quick-firing field-pieces has been lately inspected by the King of Italy on the Polygon, near Rome. The results obtained are reported by the "Esercito Italiano" to have been extraordinarily satisfactory both with regard to the accuracy of fire of the guns and the ease and celerity with which they could be manœuvred and brought into action. The guns, carriages, projectiles and entire equipment are exclusively of Italian manufacture—the guns, of steel, having been made in Turin and the carriages and other accessories in the military arsenals in Terni, Genoa and Naples, while the projectiles have been furnished by the Glisenti Company in Brescia. The calibre of the guns is 75 millimeters (2.96 inches). The projectiles weigh 6.7 kilogrammes (14.7 lbs.) and have a muzzle velocity of 500 metres (1,640 feet) with a range of 7,000 metres (7,655 yards). The weight of the gun itself is 350 kilogrammes (practically 7 cwt.), or of the gun with its carriage and limber, 1,700 kilogrammes (33 cwt.)—*United Service Gazette*, London.

GUNS: FIRING

NOTE.—Under this head will be given notes referring to firing tests of guns, target practice, special practice, accidents to guns while firing, etc.

SCORPION EXPERIMENTS.—Interesting experiments to test the effect of gun fire on warships were held at Hamilton, Bermuda, May 14, under the direction of British naval officers. The old iron-clad Scorpion was used for a target vessel, and a number of dummy figures were set up on her in different places to represent her crew. The warship Crescent then took a position at from one to two thousand yards and began firing. Unofficial advices concerning the firing state that the first shots fired at the Scorpion were from 3-pounder and 6-pounder quick-firers at one to two thousand yards range. Afterward the Crescent steamed off to about six thousand yards and opened fire with her 6-inch guns. The quick-firers played havoc with the dummy figures, and everything destructible on the Scorpion's decks, showing it would have been impossible for any crew to survive such a fire. The firing from the bigger guns, although the shells were accurately placed, was not so good. Out of about twenty shell only two or three hit the mark. These, however, were very destructive, and it is understood that the effect of the lyddite shell was regarded as satisfactory. One shell, which burst inside the Scorpion, practically wrecked everything on board.—*Army and Navy Journal*, June 15.

NEW BRITISH 12-INCH GUNS: SPEED OF FIRE.—According to *Engineer* of June 26, at recent trials at Portsmouth the gunners succeeded in firing one projectile of 850 pounds every 24 seconds from a 12-inch, 50-ton gun supplied with the new breech mechanism.

NEW BRITISH 12-INCH GUNS: MOUNTS AND SPEED OF FIRE OF THE GUNS OF THE FORMIDABLE.—During last month H. M. S. Formidable carried out her gun trials under the supervision of Captain A. Barrow, of H. M. S. Excellent, gunnery school, in most successful fashion. The tests were of especial interest, since this battleship is the first to be fitted with an improved design of hydraulic machinery, designed and supplied by Sir W. G. Armstrong, Whitworth, and Co., Ld., which provides facilities for a considerable increase in the rate of fire of the main armament of 12-inch guns, and incidentally for an increase in the charge of ammunition. In this system there is a special chamber immediately below the

gun platform to which the charges are raised independently of the guns, so that one or two charges may be in waiting in close proximity to each gun of the battery only awaiting a comparatively small final hoist into the loading position. The rate of fire is therefore practically controlled by the efficiency of the crew actually working the gun, and their operations are also aided by a new departure, which allows of the loading being done when the gun is inclined at an angle of only 4½ deg., as compared with the hitherto prevailing inclination of 13½ deg. As this smaller elevation corresponds to a range of about 4,000 yards, it will be seen that in action the tilt of the gun for loading would often be an almost negligible quantity occupying a minimum of time. In the trials, six rounds were fired in salvos of two each, in 144 seconds, so that each gun actually fired two rounds in rather less than a minute.—*Arms & Explosives*, July, 1901.

NEW VICKERS 9.2-INCH GUN: SPEED OF FIRE.—The Vickers 9.2 gun has attained a rate of fire of three rounds a minute off Portsmouth on several occasions. The Elswick 9.2 worked out at two rounds a minute, or rather two rounds in about fifty seconds. It is not possible, however, to draw comparisons exactly, because the crew which fired the Vickers gun had previously fired the Elswick, and so acquired an additional amount of handiness. There seems little doubt, however, that some speed advantage lies with the Vickers piece, which has a quicker breech action owing to the steep cone system of obturator pad. Against this, certain disabilities in the steep cone system may be put, so that, all told, it is doubtful whether in actual as opposed to experimental practice one gun will be quicker than the other. From such reports as have reached us we should be disposed to place the rate at ten in five minutes for both, the Elswick gun doing a regular two per minute, the Vickers alternating between three in one minute and one in another.—*Engineer* (London), May 31.

NEW ELSWICK 9.2-INCH GUN: ALLEGED SPEED OF FIRE.—In the London *Engineer* of May 10, 1901, the following note appears:

"The Elswick 9.2-inch mounted on the Cressy has got off rounds at the rate of one per six seconds—five rounds in thirty seconds. Now, though this must be discounted somewhat to get at a probable war rate, it must be definitely accepted that the gun can fire at least once in a minute in action."

The compiler's credulity has frequently been stretched to great limits by reports of speeds of firing attained abroad, but this is *un peu trop fort*. The liberal discount made by the writer in the *Engineer* is remarkable if he believed the report.

NEW VICKERS 6-INCH AND 7.5-INCH GUNS: TRIALS, SPEED OF FIRE.—A series of trials of the 6-inch and 7½-inch guns of 50 calibers, mounted on naval quick-firing mountings, was recently made on the gun range at Eskmeals, in Cumberland, by Messrs. Vickers, Sons and Maxim, Ld., before members of the special Naval Spanish Commission. This commission had previously been making a round of visits to the polygons at Essen, Creusôt, and St. Chamond. It was found that, thanks to the special arrangement of the mounting, in conjunction with the new breech mechanism, five aimed rounds could be fired in 37 seconds from the 7½-inch gun, or at the rate of eight aimed rounds per minute. This rate of fire is similar to that obtained from the latest pattern of Vickers' 6-inch guns, at the official trials. Without exceeding the limits of the working pressure of the guns, the 6-inch gun gave a muzzle velocity of

2,900 feet per second, and the 7½-inch gun 2,903 ft. per second. The weight of the projectile for the 7½-inch caliber is 200 lbs., giving a muzzle energy of 11,687 ft. tons.—*Arms & Explosives*, July 1901.

VICKERS 14-CM. AND 6-INCH GUNS: SPEED OF FIRING, ETC.—Some important gunnery experiments were carried out on Tuesday at the heavy range of Messrs. Vickers, Sons, and Maxim, at their range at Eskmeals, in the presence of the members of the Spanish Naval Artillery Commission and representatives of the Turkish, Argentine, Mexican, and Peruvian Governments. The programme included rapid-firing series from 14-centimetre, 14-pounder, 37 and 47-millimetre guns. A rate of fire of ten rounds per minute was obtained from the 14-centimetre gun, and a velocity of 2950 ft. per second with the 6-inch gun with nitrocellulose powder. The special feature in connection with the rapid-firing series with the heavy guns was that no metallic cases were utilized for holding the powder, whereby a great saving in weight of ammunition as carried on board ship is effected, and a much more rapid rate of fire is obtained. The cartridge cases necessary to carry the large charges of powder to develop the high energies required are very heavy, and by their use the rate of fire is not only reduced, but the weight of the whole armament is much increased, thereby limiting the number of rounds it is possible to carry. The system of not making use of cartridge cases for heavy ordnance has been adopted by the British Government, as opposed to the cartridge case system employed by Krupp and the French firms.—*Engineering* (London), May 24.

TARGET PRACTICE IN THE BRITISH NAVY: PRIZE FIRING OF THE TERRIBLE.—Last week we referred to the fact that the Terrible has just returned into harbor from prize firing, and that with her twelve 6-inch guns she had fired 128 rounds and made 102 hits. Further information has now come to hand on the subject. The Service prize-firing target was used, the distance 1,400 to 1,600 yards, the speed of the ship twelve knots, and weather fine with a moderate swell. Each gun fired at the target for two minutes, the hits were then counted by independent umpires from other ships. As it was anticipated that the firing would be more rapid than it is generally accepted 6-inch guns can do, extra independent umpires were taken out to carefully verify the time for each gun, and as an additional precaution an attempt was to be made to photograph the target after each gun had fired. It will be remembered that last year this ship headed the list of the fleet with a percentage of hits of 76.8, and an average of hits per gun per minute of 3.33. The following table gives the prize firing of seven ships similarly armed (twelve 6-inch quick-firing guns) in 1900:

Ship.	Number of rounds fired.	Number of hits.	Percentage of hits to rounds fired.	Average hits per gun per minute
Terrible.....	104	80	76.8	3.33
Majestic.....	108	52	48.1	2.17
Prince George....	93	52	55.9	2.17
Jupiter.....	106	44	41.5	1.83
Magnificent.....	87	30	34.5	1.25
Mars	95	27	28.4	1.13
Hannibal	79	27	34.2	1.13
Terrible (1901)...	128	102	79.6	4.25

Last year it will be seen that the Magnificent, Mars, and Hannibal, with their thirty-six guns made a total of eighty-four hits while the Terrible, with twelve guns, made eighty hits, four short of their total.

This looks as if the Terrible was as good as three battleships. It has, however, been argued by some that, although the three battleships missed the target 180 times, they missed it by so little that they would have hit a battleship. That may be, but a battleship's target is not always a battleship. The prize-firing target's canvas is 20 ft. long and 18 ft. high (360 square feet in area), and it is surprising that three battleships should miss such a large target 180 times out of 260 shots at the comparatively short range of 1,400 to 1,600 yards. How often, it may be asked, would they have hit a fast approaching destroyer?

This year the Terrible appears to have fired much quicker than last year, the rounds fired with the twelve guns being 128, as against 104 last year. Rapidity of fire must (or should) conduce to more hits, as there is less time for the distance to change between the rounds. It is, therefore, most important to encourage it, and comparisons between ships should be made on hits per minute, not upon percentage of hits to rounds fired. The challenge cups presented by Admiral Sir Edward Seymour to his squadron for the best shooting with heavy guns and small arms shows that he has a full appreciation of the value which should be attached to good shooting, and the competition for them will probably tend to raise the standard of shooting with both weapons. In all functions on shore, where representatives from different ships are present, it has always been the custom for the flagship to take the right of the line, but, according to Sir Edward Seymour's memorandum, in future the ship holding his cup for rifle shooting will take the right of the line. These are all indications of a greater interest being taken in both heavy gun and rifle shooting than heretofore (and not before it is wanted); but it is not only the officers who must take an interest, the Admiralty must give encouragement, as we have already suggested, by letting officers know that polishing brasswork is no longer to be the sure and only path to promotion.—*Army and Navy Gazette*, June 22.

Bursting of a 12-Pounder Gun.—A cable from London, England, June 25, announces that during artillery practice on the Isle of Wight, the breech of a twelve-pound rifle blew out, killing Capt. A. LeM. Bray of the Royal Regiment of Artillery, and one enlisted man, and wounding eight other men, three of whom will die. Col. A. J. Nixon, of the same regiment, was also slightly wounded by the explosion.—*Army & Navy Journal*, June 29.

Proposed Test of Mortar Batteries.—The Board on Ordnance and Fortifications has agreed upon the program which will be followed at the coming official test of mortar batteries to be held at Fort Preble, Me. The program is as follows:

1. Have a local board of three artillery officers to determine the equipment required and conduct all the firing.
2. Test the co-ordination of the position finders with each other and with the mortar battery at Fort Preble by directing the position finders upon fixed and moving objects.
3. Test and determine the probable error of the position finders employed.
4. Establish two secondary horizontal lines in connection with the two vertical position finders—one at Fort Williams and one to be installed on Cushing's Island. In addition there should be properly oriented azimuth instruments on Peaks' Island and Jewell's Island for observing the fall of the shots.

5. Arrangement should be made if practicable for obtaining during the firing test the direction and strength of the wind in the morning at Mount Washington. This is desirable, because at the height of Mount Washington and above the wind is generally from the northwest without reference to the direction the surface wind may have at Portland.

6. Mark out, if practicable, on each of the islands—Ram, Inner Green and Outer Green—a target the size of the deck of a battleship. Fire single shots from a mortar pit at Ram Island until one shot falls near the target. Repeat this operation from a second mortar pit for Inner Green, and again from a third pit for Outer Green. With the elevations and azimuths thus determined fire four shots from each of the three mortar pits, with an interval of two minutes between shots. This method is preferred to salvo, since the fall of each particular shot should be identified and the atmospheric conditions of the firing will be the same as if all the shots were fired by salvo.

7. Shots should be fired at the targets on different days, with a fixed powder charge, azimuth and elevation, to ascertain the best means of applying correction to mortar fire. That is, to settle the question of whether or not such correction shall be determined from trial shots for the day or from the surface atmospheric conditions.

8. In this test data should be collected for the preparation of range tables with smokeless powder.

9. A range zone being the area in which, with a consonant weight of powder, the elevation is varied, there should be determined the most suitable boundaries of the range zones and the methods of passing by elevation from one range to another within the same zone.

10. As this test should be wholly under service conditions, use only smokeless powder of a uniform quality and projectiles of a uniform weight.

11. In firing, use each pit of the battery in succession and in each pit each gun in succession.

12. Determine the highest elevation of the mortar at which the axis of the projectile will continue tangent to the trajectory.

13. After the completion of fire at fixed targets, fire at either a moving material target or a hypothetical moving target.—*Army & Navy Journal*, June 13.

BIBLIOGRAPHIC NOTES.

[AMERICAN.]

ARMY AND NAVY JOURNAL.

JUNE 22, 1901. Not a New Explosive. Defenseless Canada. Submarine Boats. Interesting Rifle Experiments. General Bates on Datto Mundi. National Guard as a Reserve. The Boer War and England's Supremacy. Reports on the Boer War. Trial of the Wisconsin. Field Manœuvres, First Brigade, N. Y. War on the Hudson. New German Mauser, Model 98. Shields for Field Guns.

JUNE 29. China and the Allies. Officering the Army. The Future of the Lance. Hazards in War and Peace. Trial of the Wisconsin. Explosion at Mare Island. Graphic Comparison of Heavy Guns.

JULY 6. How Clothes Kill Natives. How the French See Us. Our Troops in China. Properties of Maximite. Report on the Illinois. Government by Philipinos.

JULY 13. Ordnance and Fortifications. Advantages of Military Training.

JULY 20. Admirable Work of Ordnance Board. Foreign View of Gettysburg. General Funston's Report. The Superposed Turret. The Latest Turbine Steamer. Design for a Seagoing Battleship. The Perry Expedition to Japan.

AUGUST 10. The Threat of War. The Turkish View of Cowardice. French Submarines. British and French Naval Manœuvres. Trial of the Torpedo-boat Biddle. Control of Infantry Fire.

AUGUST 17. Medical Hints for the Tropics. British Army Weaknesses. No Use for Conning Towers. Admiral Melville on Modern Warships. U. S. Dock at Subig. Sailers or Steamers for Training. "The Graydon" in Submarine Warfare.

AUGUST 24. French Naval Manœuvres.

AUGUST 31. Results of a Single Victory. History of Our Army. Our Naval Program. The Cuban Artillerymen. Lessons in Ship Failures. Drill of the North Atlantic Squadron.

SEPTEMBER 7. The Value of Submarine Boats. Our New Army. Some Points in Coast Defense. Our Transport Service. Gun Training and Practice. Naval Progress, 1900-1901.

SEPTEMBER 14. Risks in Modern War. Rapid Repair in Modern War Wounds. New Foreign Field Guns. A General Staff for the Army. Corps of Artillery. Segmental Wire-wound Guns. The English Boiler Tests. Comparative Efficiency of Small Arms.

SEPTEMBER 21. Is Gibraltar a Safe Defense? William McKinley. Theodore Roosevelt. The Policy of the President. Gunnery Practice for the Navy.

SEPTEMBER 28. Discipline and Tyranny.

ARMY AND NAVY REGISTER.

JUNE 22, 1901. Our Ancient Militia Laws. Maxim and His Ite. Reports of Operations in China. Report of Visitors to the Naval Academy.

JULY 6. The Naval Militia. The Mechanics and Valor of War. Rations to Officers on Sea-going Vessels. Foreign Service Notes. Mare Island Explosion. Launching of the Maine. Electric Fireproofing. The Boston Dry Dock.

JULY 13. Pay of Rear-Admirals. Philippine Operations. A Board's Good Work. Need of Naval Program. The Delays on Naval Ships. The Bureau Chiefs. Russia in Manchuria. Mortar Tests. Notes on Naval Vessels. Success of the Zede.

JULY 27. Minority Report on Battleships. French Submarines. Naval and Private Shipbuilding. Torpedo-boat Board.

AUGUST 3. Reports on Battleships. A Home Critic of the British Navy.

AUGUST 10. Report on Occupation of Camp Higginson. Manila Nautical School. Report on Drills of the Iowa and Wisconsin. Secret Service in Manila. The British Naval Manœuvres.

AUGUST 17. Report on the Iowa's Marines Ashore. The New Artillery Officers.

AUGUST 24. North Atlantic Fleet Manœuvres. A Naval Reserve.

AUGUST 31. Naval Gun Drills. Battleship Illinois. Notes on Naval Progress. Naval Engineer Duty.

SEPTEMBER 7. The Evolution of Bunker Filling.

CASSIER'S MAGAZINE.

JULY, 1901. Railway Engineering in China. Electric Cable Making. The Efficiency of Marine Boilers. Locomotive Building in the United States. Some American Turret Lathes.

AUGUST. The Nile Reservoirs. The Machinery of Torpedo-boats. Alternating Current Power Work.

SEPTEMBER. The Glasgow Exhibition. The Tool, the Machine, the Man. The Measuring Machine in the Workshop.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

AUGUST, 1901. Contract trial of the United States Seagoing Battleship Illinois. Contract Trials of the Torpedo-boats Shubrick and Thornton. Mercantile Auxiliaries. Conversion and and Re-armament of Ships on the Effective List. The Grounding of the German Battleship Kaiser Friedrich III. U. S. Torpedo-boats Bagley, Barney, and Biddle. On the Limit of Economical Speed of Ships. Triple-screw Ships.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

JULY, 1901. Artillery Organization. Clothing and Equipment. Meat Ration in the Tropics. The Negro Volunteer. Visit of the Allies to China. Campaign in Orange Free State.

SEPTEMBER. Military Topography. Some points of Tactics. Supply and Distribution. Field Service Instruction. French Autumn Manœuvres.

JOURNAL OF THE UNITED STATES ARTILLERY.

JULY AND AUGUST, 1901. Organization of the Field Artillery. Sights for Direct Fire Guns. The Spanish Defenses of San Juan, Porto Rico. The Development of the Krupp Field Artillery Material. The 16-inch Breech-loading Rifle. The Study of Sea Power. Experiments in Illustration of the Top Motion of Rotating Oblong Projectiles.

MARINE ENGINEERING.

JULY, 1901. Launch of the Battleship Ohio. Stability of Steamers After Collision at Sea. Liquid Fuel for Merchant Steamers. U. S. S. Mayflower. Steam Jackets and Their Efficiency. Direct Connected Air Pumps. Cruising Motor Launch. Japanese School of Marine Engineering.

AUGUST. Compound vs. Triple-expansion Engines. French Battleship Hoche. Shooters Island Shipyard. Trials of the U. S. Torpedo-boats Bagley and Barney. Stability of Steamers After Collision at Sea. Belleville vs. Scotch Boilers.

SEPTEMBER. Theoretical Indicator and Valve Diagrams. Floating Dock for the Spanish Government. Mercantile Auxiliaries. United States Frigate Hartford. School of Marine Engineering, University of Michigan.

SCIENTIFIC AMERICAN.

JUNE 22, 1901. American Locomotives Abroad. Our Fastest Battleship. An Adjustable Power-hammer. Launch of the Submarine Torpedo-boat Fulton. The Three Cup Yachts of 1901. The Stralau-Treptow Tunnel Under the River Spree.

JUNE 29. Reconstruction of German Cruisers. Curious Docking Accident. Water Supply System of Chicago.

JULY 6. Height of Ocean Waves. Coke as a Substitute for Anthracite Coal. New Breech-loading Quick-firing Gun. The Factor of Safety in Yachts. The Restoration of Star Photographic Negatives.

JULY 13. Report of Royal British Observatory for 1900. Admirable Work of the Ordnance Board at Sandy Hook. An Improved Double-Cylinder Force Pump.

JULY 20. The Struggle of the Cup Champions. Introducing American Methods in England. Oil for Marine Use. Two of the Latest Types of Battleships. Marconi's Wireless Telegraphy. Automobile for Military Purposes. Cost of English and American Locomotives.

AUGUST 3. Future Reconstruction of the Brooklyn Bridge. Recent Developments in the British Navy. A Wave Motor.

AUGUST 10. Supervision and Safety of the Brooklyn Bridge. The Santos-Dumont Balloon.

AUGUST 17. Mishap to the Santos-Dumont Airship. Big Ships and Deep Waterways. Water-tube vs. Fire-tube Boilers for Naval Use. The Naval Program for 1901.

AUGUST 24. Vulnerability of the Superposed Turret.

SEPTEMBER 7. A Promising Type of Gun. The Design of Propellers. Marconi Telegraphs on the British Fleet. New 5-inch Segmental Wire-wound Gun for the United States Army.

SEPTEMBER 14. Target Practice at Aldershot.

SEPTEMBER 28. Foster's Fog Signals.

[FOREIGN.]

ENGINEERING.

JUNE 14, 1901. The Development of Smokeless Powder in the United States. The Drift of Projectiles.

JUNE 23. Babcock and Wilcox Boilers at the Glasgow Exhibition. Illustrated. Oil-burning Torpedo-boat. Illustrated. The Navy Estimates. The Welin Boat-lowering Gear. Illustrated.

JUNE 28. The Shallow-draught Gunboat Teal. Illustrated. Conversion and Re-armament of Ships on the Effective List. Speed of Ships. Illustrated.

JULY 5. The King Edward. Illustrated. The Naval Architects and the Navy. The Dutch Torpedo-boat Rindjani. The Development of Smokeless Powder. On Freeboards. Illustrated. The Transverse Strength of Ships. Illustrated.

JULY 12. Erosion of Guns. Illustrated. Drift of Projectiles. The Condition of the Navy. The United States Transport Service. Trials of H. M. First-class Battleship Vengeance.

JULY 19. Schneider-Canet Quick-firing Guns and Howitzers for Field Service. Illustrated. The United States Army Transport Sumner. Illustrated. The Constructive Development of the Dürr Boiler in the German Navy. Illustrated. Shipbuilding in the United States. Balancing Marine Engines; the Prevention of Vibration. Erosion of Guns. The Drift of Projectiles. A Solution of the Vibration Problem. Illustrated.

JULY 26. Schneider-Canet Quick-firing Guns and Howitzers for Field Service. Illustrated. Vickers' Gun-mounting Works at Barrow-in-Furness. Illustrated. Navy Boilers. The Minerva and Hyacinth Trials. Capped Armor-piercing Projectiles. The German Navy. Illustrated.

AUGUST 2. Naval Ordnance. Illustrated. High Explosive Shells. The Constructive Development of the Dürr Boiler in the German Navy. Illustrated.

AUGUST 9. The Naval Manœuvres. High Explosive Shells. Naval Ordnance. Illustrated.

AUGUST 16. Schneider-Canet Quick-firing Guns and Howitzers for Field Service. Illustrated. The United States Army Transport Sumner. Illustrated. Foreigners on British Ships. Naval Ordnance. Illustrated.

AUGUST 30. The Boiler Trials of H. M. S. Minerva and Hyacinth.

SEPTEMBER 6. Coal-weighing and Recording Machine. The Proposed Tunnel Between Scotland and Ireland. The Displacement and Dimensions of Ships.

SEPTEMBER 13. The New German Atlantic Liner Kronprinz Wilhelm. The Improvement of the Lower Mississippi River.

SEPTEMBER 20. The Whitehead Torpedo Works at Flume. German Shipping Bounties. Recent Improvements in the Lighting and Buoying of the Coasts of France. Illustrated. The Steamboat Equipment of Warships.

JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

JUNE, 1901. Nelson Relics. Our Food Supply in Time of War, and Imperial Defense. The Capture of the Taku Forts. The South African War of 1899-1900.

JULY. New French Battleship Gaulois. Second Military Prize Essay, Subject: "Lessons to be Derived from the Expedition to South Africa in Regard to the Best Organization of the Land Forces of the Empire." Some Impressions of the War in South Africa. The South African War of 1899-1900.

AUGUST. National Defense: The duties likely to devolve on the volunteers in connection therewith; some suggestions as to how we may best fit ourselves for the task. The Native Question in South Africa. The Canteen Question. The South Afri-

can War of 1899-1900. The Execution of the Field Defenses of London. The Elswick Battery in South Africa.

SEPTEMBER. New French First-class Cruiser Guichen, 8300 tons; I. H. P., 25,000. Army Reform. The Necessity for an Advisory Board. Some Ideas of a South African About the War. The South African War of 1899-1900. Garrison Artillery Company in the Field.

LE YACHT.

JUNE 1, 1901. International Maritime Questions and the Congress of Monaco. The Dismasting of Shamrock II. The Naval Manœuvres of 1901.

JUNE 8. International Maritime Questions and the Congress of Monaco (concluded). The Trials of the Submarine Boats Narval and Holland. The New Italian Battleship Regina Margherita. The Cadet School Duguay-Trouin. The Mercantile Marine: French and Foreign.

JUNE 15. The Deficiency of the Personnel of the Navy: the Necessity for Increasing the Officers' Cadres. Benzine Motor for Boats. Naval Estimates for 1902.

JUNE 22. The Salvage of Ships. The Coast Defense Ship Tempete. The Mercantile Marine: French and Foreign.

JUNE 29. The New Regulations for the Mercantile Marine. The Naval Manœuvres.

JULY 6. Employment of Wireless Telegraphy in the Navy. The Naval Manœuvres. The Mercantile Marine: French and Foreign.

JULY 13. The Composition of the Squadrons and Naval Divisions in 1902. The Naval Manœuvres.

JULY 20. The Naval Manœuvres. The Mercantile Marine: French and Foreign.

JULY 27. The Naval Manœuvres. The Turbine Mail Steamer King Edward.

AUGUST 3. The Naval Manœuvres. Floating Docks. The Mercantile Marine: French and Foreign.

AUGUST 10. The End of the Manœuvres.

AUGUST 17. The New Submarines. The Turkish Navy. The Mercantile Marine: French and Foreign.

AUGUST 24. The English Manœuvres of 1900.

AUGUST 31. The New Arrangement of Our Squadrons in European Waters. The Russian Battleship Peresviet. The Mercantile Marine: French and Foreign.

RIVISTA MARITTIMA.

JULY. Types of Armored Ships for the Line of Battle and Cruising. Launch of the Regina Margherita. The Evolution of Coast Defense in the 19th Century. Naval Notes.

AUGUST-SEPTEMBER. The Protection of Ships in the 19th Century. Power Operation of Guns: Hydraulic or Electric Power. Naval Notes.

REVUE MARITIME.

JULY. The present British Fleet and Its Development (translation). Naval Notes.

AUGUST. The Naval Campaign in the Channel in 1779. Naval Notes.

THE ENGINEER.

JUNE 14, 1901. Steam Engines at the Glasgow Exhibition. Gate Machinery for the Mersey Docks. Armor-plate Manufacture in Germany.

JUNE 21. The Defense of Coaling Stations. Steam Engines at the Glasgow Exhibition. The French Naval Manœuvres. Coal Values.

JUNE 28. Naval Boilers. Progress of Warships and Machinery Building in England. The Antidote to Submarines.

JULY 5. Steam Engines at the Glasgow Exhibition. The American Coal Trust. All the World's Fighting Ships. Floating Dock for Minorca.

JULY 12. The Minerva and Hyacinth. The American Cup Race. The New Battleships. H. M. Cruiser Leviathan. A Huge Liquid Fuel Burner.

JULY 19. Shermuly's Life-saving Apparatus. H. M. Ships Minerva and Hyacinth. Water for Steam Engines. H. M S. Cornwallis.

JULY 26. Steam Engines at the Glasgow Exhibition. New Protected Cruisers for the United States Navy. Illustrated. Santos-Dumont Navigatable Balloon.

AUGUST 2. Electric Machinery at Glasgow. Modernizing Ironclads. Explosions of Historical Locomotives. Naval Ordnance.

AUGUST 9. New Marine Works at Naples. American Locomotives in England. Review of Marine Engineering During the Last Ten Years.

AUGUST 16. Inward-flow Turbines. Boilers at the Glasgow Exhibition. Torpedo-boat Destroyers. Review of Marine Engineering During the Last Ten Years.

AUGUST 23. Annual Report on Explosives. Atlantic-Mediterranean Canal. Submarine Railway Tunnel at Boston. The Naval War Game. Armor-plate Trial. The Lesson of the French Naval Manœuvres. Wreck Statistics for 1900. The Progress of Marine Engineering During the Last Ten Years. Illustrated.

AUGUST 30. American Locomotives in England. Engineering in the Royal Navy. No. I. New York and the Great Lakes. Slip of Screw Propellers. Development of the Mode of Ignition in Small Arms and Artillery. No. V. Illustrated. Trials of H. M. S. Minerva and Hyacinth.

SEPTEMBER 6. Engineering in the Royal Navy. No. II.

SEPTEMBER 13. Blind Shells. Deepening the Sea of Azoy. More Guns. Irrigation of the Nile Valley and Its Future. Illustrated.

SEPTEMBER 20. The French Combined Naval and Military Western Manœuvres. Development of the Mode of Ignition in Small Arms and Artillery. No. VI. Illustrated. President McKinley. The loss of the Cobra. The Railway Ferry Steamer and Ice-breaker Scotia. Illustrated. The Newest Norddeutscher Lloyd Liner. Approximate Rules for the Determination of the Displacement and Dimensions of a Ship.

UNITED SERVICE GAZETTE.

JUNE 15, 1901. A New Machine Rifle. War Office Organization.

JUNE 22. The Cossack. Turkey (Asiatic) Mounted Militia. Training Ground in South Africa. The Treatment of the Militia. The Transvaal War.

JUNE 29. Admiralty Works at Gibraltar. The Transvaal War. The Increase of Freedom in Russia and the Increase of Restraint in England. The War and Its Lessons. M. de Bloch on the War. The Gun Power of Cruisers.

JULY 6. The Resemblance of the Cossack Character to the English. Admiralty Surveys During 1900. The Navy and the Mediterranean.

JULY 13. Russian Officer's Account of the Recapture of Spion Kopje.—I. The Strength of the Navy. A South African on the War. The Navy in Parliament. The New Shipbuilding Program.

JULY 20. Balloons in Warfare. A Russian Officer's Account of the Recapture of Spion Kopje.—II. Naval Training.

JULY 27. Australian Defense. The Cavalry Manœuvres.

AUGUST 3. The Transvaal War. Naval Ordnance. The Naval Manœuvres. Naval Volunteers.

AUGUST 10. The Transvaal War. The Naval Manœuvres. —II.

AUGUST 17. Some Notes on the Naval Manœuvres.

AUGUST 24. Naval Scouts. Russia and the Balkan States Combining to Resist the Teutonic Aggression in the East. Military Policy and Imperial Needs.

AUGUST 31. Russia's Naval Power in the Baltic and the Summer Manœuvres of the St. Petersburg Garrison.

SEPTEMBER 7. The Naval Development of the Nineteenth Century. The Transvaal War.

SEPTEMBER 14. Floating Docks. Steamboat Equipment of Warships.

THE STEAMSHIP.

JUNE, 1901. Compound Surface-condensing Marine Engines. Marine Boiler Explosions. Speed at Sea. The Asral. The Marine Steam Turbine and Its Application to Fast Vessels. An Instrument for Measuring the Rolling of Ships. The Conversion of Old Marine Engines.

JULY. Combined Boiler Circulator and Feed-water Heater. Marine Boiler Explosions. How should Boiler-heating Surfaces be Calculated. Water-tube boilers. Report on Steam Turbines. A New Lightship.

AUGUST. On Screw Propellers. Engineering in China. The Crompton Ash Hoist. Illustrated. H. M. S. Leviathan. Holzapfel's Compositions. New Method for Testing the Strength of Iron and Steel. Steam Turbines and Superheated Steam. The Water-tube Boiler Question in the German Navy. Causes of Heating in Metal Bearings.

SEPTEMBER. Electrical Deck Planer. Illustrated. Marine Boiler Explosions. Benedict Nickel Seamless Tubing. Illustrated. Report on Steam Engines and Boilers. The Pendulum Propeller. Circulating Condensing Water Without a Pump. The New Turbine Steamer King Edward. Illustrated. Liquid Fuel Aboard Ships.

OFFICERS OF THE INSTITUTE.

President.

REAR-ADMIRAL WILLIAM T. SAMPSON, U. S. NAVY.

Vice-President.

COMMANDER RICHARD WAINWRIGHT, U. S. NAVY.

Secretary and Treasurer.

LIEUTENANT L. S. VAN DUZER, U. S. Navy.

Board of Control.

Commander C. E. COLAHAN, U. S. Navy.
Lieutenant-Commander J. P. PARKER, U. S. Navy.
Lieutenant-Commander J. E. CRAVEN, U. S. Navy.
Lieutenant-Commander JOHN HOOD, U. S. Navy.
Professor P. R. ALGER, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Lieutenant L. S. VAN DUZER, U. S. Navy (ex officio).

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1901.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1902. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute. If the essayist second in order of merit receive "Honorable Mention," he will also be made a life member.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

L. S. VAN DUZER,
Lieut., U. S. N., Secretary and Treasurer.

ESTABLISHED 1780.

WALTER BAKER & CO.'S

Breakfast Cocoa

TRADE-MARK.

Pure, Delicious, Nutritious.

Costs Less than ONE CENT a Cup.

Baron von Liebig, one of the best-known writers on dietetics, says :—

"It is a perfect food, as wholesome as delicious, a beneficent restorer of exhausted power; but its quality must be good, and it must be carefully prepared. It is highly nourishing and easily digested and is fitted to repair wasted strength, preserve health, and prolong life. It agrees with dry temperaments and convalescents; with mothers who nurse their children; with those whose occupations oblige them to undergo severe mental strains; with public speakers, and with all those who give to work a portion of the time needed for sleep. It soothes both stomach and brain, and for this reason, as well as for others, it is the best friend of those engaged in literary pursuits.

"Walter Baker & Company, of Dorchester, Mass., U. S. A., have given years of study to the skilful preparation of cocoa and chocolate, and have devised machinery and systems peculiar to their methods of treatment, whereby the purity, palatability, and highest nutrient characteristics are retained. Their preparations are known the world over and have received the highest endorsements from the medical practitioner, the nurse, and the intelligent housekeeper and caterer."—*Dietetic and Hygienic Gazette.*

Be Sure that the Package Bears our Trade-Mark.

WALTER BAKER & CO. LIMITED,

DORCHESTER, MASS.

Horizontal
Outside Pump
Hydraulic Jack.
Sheet 20.

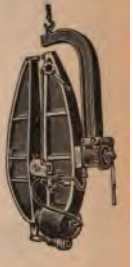
HYDRAULIC TOOLS

AND

MACHINERY

FOR

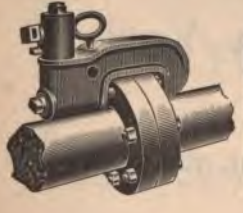
Marine and Ship-Yard Use.



THE WATSON-STILLMAN CO.

204 to 210 EAST 43rd STREET,

NEW YORK.



A SCIENTIFIC PREPARATION.

TABASCO PEPPER SAUCE

OR Liquid Pepper.

INDISPENSABLE FOR THE MESS.

• •

KEEPS IN ANY CLIMATE.

• •

ALWAYS PURE AND WHOLESOME.

A NECESSITY IN THE GALLEY.

• •

A LUXURY FOR THE TABLE.

• •

UNEQUALED IN STRENGTH AND FLAVOR.

MANUFACTURED ONLY BY

E. McILHENNY'S SON, ✣ NEW IBERIA, LA., U. S. A.

Originators of Condensed Milk. Established in 1857

GAIL BORDEN EAGLE BRAND

. . Condensed Milk

The best known brand
of milk in the world.

(The standby of the Army and Navy.)

BORDEN'S PEERLESS BRAND

Evaporated Cream

A complete, PURE, RICH and WHOLESOME UNSWEETENED CONDENSED MILK, sterilized and thoroughly prepared for indefinite keeping.

Always ready. Water only required. 1-lb. cans.
Has no Competitor.

BORDEN'S EAGLE BRAND

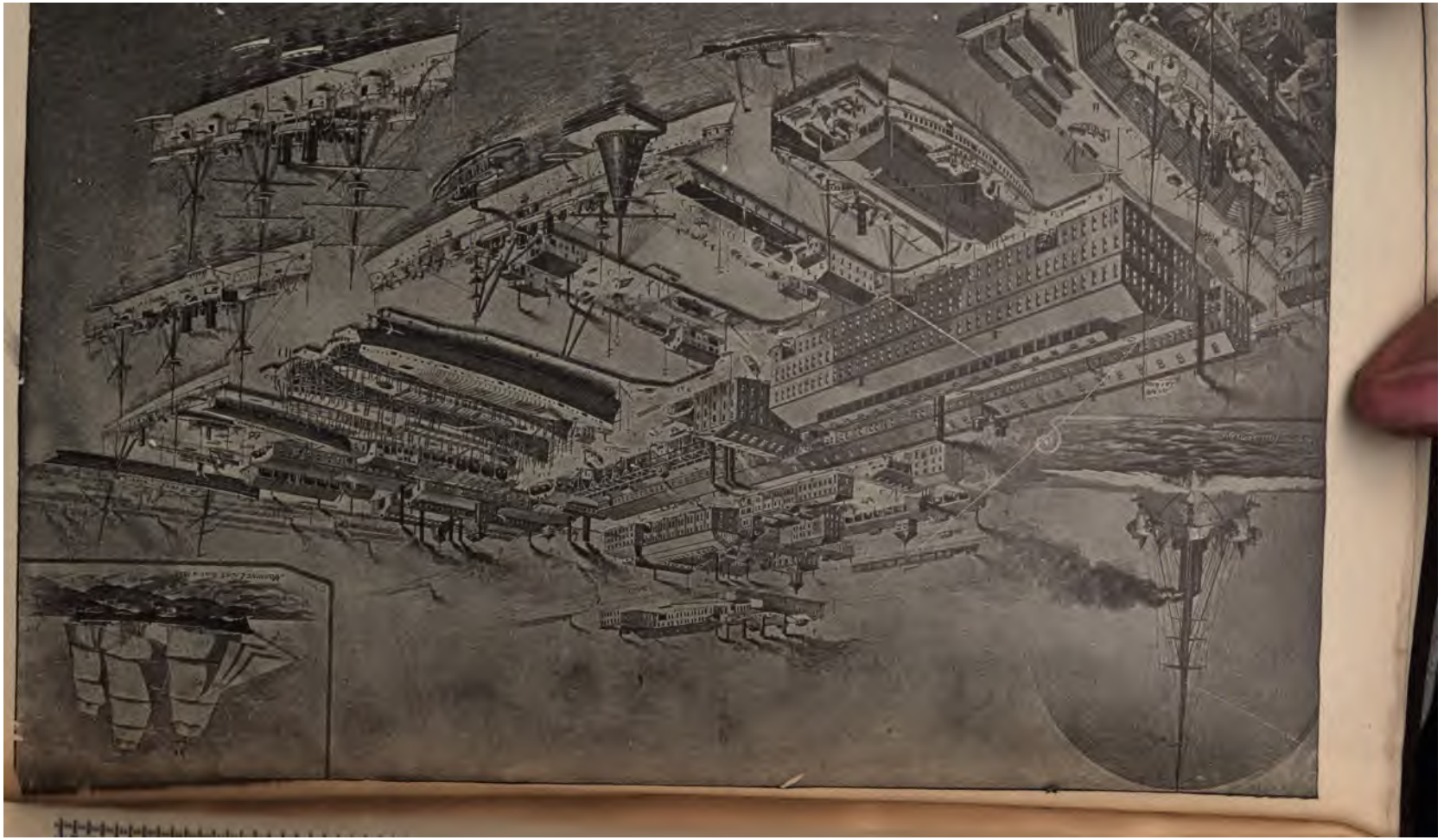
Condensed Coffee

These brands prepared by the BORDEN'S CONDENSED MILK CO., are the universally recognized standards of excellence and purity. Quality fully guaranteed.

BORDEN'S CONDENSED MILK CO.

Successor NEW YORK CONDENSED MILK CO.

THE LARGEST MANUFACTURERS OF MILK PRODUCTS IN THE WORLD.



PROCEEDINGS OF THE UNITED STATES NAVAL INSTITUTE

CONTENTS.